AT&T's key to European markets ■ PC sales take off in Asia

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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

JULY 23, 1990

THE ELECTRONIC BUSINESS 200

THE LARGEST U.S. ELECTRONICS COMPANIES

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES — WORLDWIDE

VOL. 16, NO. 14 JULY 23, 1990

Cover: Dave Bradley

COVER STORY/THE ELECTRONIC BUSINESS 200

43 1989 was supposed to be a good year for electronics. It wasn't

After a promising start, 1989 turned out to be a painful year for many electronics executives. Demand weakened in the third quarter, leading to losses and layoffs by year's end. Nearly all the vital statistics for the 200 largest U.S. electronics corporations were down in 1989, despite strong performances by several of the top companies. Declining sales growth abroad and rising debt are two major problems.

UPDATE

15 Business Trends
Gorbachev's visit widens trade avenues; EDI enhances purchasing efficiency; high tech gets praise from Wall Street; sparks fly between Carla Hills and Japanese; Motorola plans satellite phone system; European firms push East Bloc ventures; new study explores intellectual property; Coiltronics and Minebea make a merger of extremes; Congress ponders lock on caller ID.

25 Economic Trends
Survey finds a world of difference in chip prices; Federal appetite still growing for IS products; Mexico lowers high-tech import barriers.

29 Companies to watch
Packaging helps to end integrated circuit slowdowns; test equipment meets Air Force standards; software automates process control.

33 Letter from China
Walking around the streets of the Shenzhen special economic zone, a visitor might conclude that China's austerity program has missed the zone completely. But Shenzhen's prosperity today is not what it was a few years ago. The tightening of credit has hurt.

37 Commentary/Manufacturing
Shorter cycles make subcontractors work harder.

THE ELECTRONIC BUSINESS 200

43 1989 was supposed to be a good year. It wasn't
The general economic slowdown of the fourth quarter of 1989 contributed to the poor results for most of the 200 largest U.S. electronics companies last year. Many companies were expecting stronger sales late in the year and were slow to trim costs. The restructuring that has gripped the industry for the past few years just has not made enough of an impact to get operating costs under control, some say.

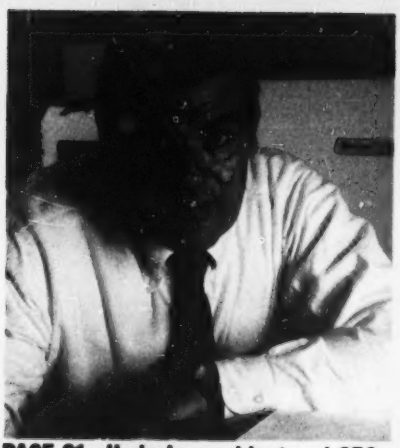
48 **Financial Tables**
61 **Industry segments**
71 **Best and worst performers**
73 **Alphabetical index**

76 IBM stumbled last year, but remains at the top
Profits dropped by a third last year, but chairman John Akers is upbeat about 1990.

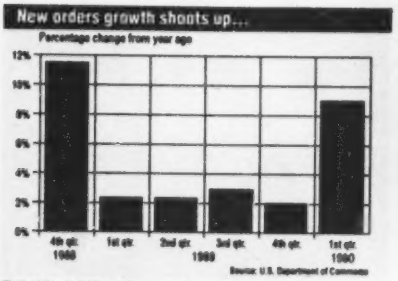
81 Hadco's 14% growth is just enough to make the final cut
Circuit board supplier says major capital investment was key to its 1989 success.

86 Quantum flies high in the race for disk drive sales
In a market where many fail, Quantum won by gambling on intelligent interfaces.

92 A battered Kollmorgen takes the big fall
1989 saw a takeover bid, a $117-million sales drop and a $19-million loss.



PAGE 81 Hadco's president and CEO Jon Kropper: Closer focus on the high end of the PC board market growth



PAGE 125 Business Barometer

PAGE 76 IBM chairman John Akers: Disappointed with his company's performance in 1989

PAGE 110 NCR Hong Kong's marketer Tony Grandidge

PAGE 15 Trying to unlock caller identification

PAGE 86 Quantum chairman and CEO Stephen Berkley: Growing "seven to 10 times as fast as the industry"

98 Newcomers to this year's ranking are a diverse group
They make everything from networking equipment to bar-code readers.

102 Gone missing: 18 companies who didn't make the grade
Acquisitions knocked 10 from the list, while others succumbed to weak sales.

EUROPE BUSINESS

106 Istel: AT&T's key to open European markets
From network services and computer systems to terminals and global messaging, AT&T is building on its acquisition of British systems integrator and network provider Istel Ltd. to launch its new European strategy. Recently, it debuted the first two building blocks of that strategy by creating two new Istel subsidiaries, one attacking the European market for global messaging, the other a British distributor for AT&T's computer products.

ASIA/PACIFIC BUSINESS

110 PC makers look to Asia for the next surge in sales
With demand from Asian markets on the rise, U.S.-based PC manufacturers like AST Research Inc. are developing aggressive marketing strategies to prepare for future growth.

112 Tiny memory cards may stall disk drive market growth
As a new international standard for high-density plug-in memory modules nears completion, it looks as though disk drives could go the way of punch-card readers.

MARKET PERSPECTIVES

115 Component makers fight falling prices, foreign markets
The U.S. passive component industry is facing an uphill battle for sales growth. Greater participation in a global standards organization may help.

BUSINESS BAROMETER

125 **Instruments**
Industry is poised for recovery.

126 **Delivery times**
Leadtimes to shorten through 1990.

DEPARTMENTS

5 **Inside Business**

9 **Letters**

119 **Advertiser index**

123 **My View**
Trade policy. More foreign investment.

128 **Viewpoint**
Windows 3.0: Now we see through a glass, darkly

COMPANIES IN THIS ISSUE

118 **An index of the companies covered in this issue.**

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1989: How Bad Was it?

Slowing demand, soaring costs, sinking profits. That pretty much sums up 1989 for the top 200 publicly held U.S. electronics companies. We offer that analysis and more from senior editors Linda Stallmann and Bruce Rayner and other staff editors in presenting our exclusive ELECTRONIC BUSINESS 200 ranking.

ELECTRONIC BUSINESS has ranked the top electronics companies since 1978. The many years of experience give us perspective, enabling us to spot and analyze trends in the industry.

Taking into account all the vital statistics of the 200 companies on our listing — including revenue, net income, return on investment and five-year-growth — we develop a clear picture of an industry for which 1989 was a disappointment. In fact, the statistics from this year's ranking resemble those of industry down years 1985 and 1986.

Bad news is not our mission here; the goal of ELECTRONIC BUSINESS 200 is to compile the data and present it in an easily digestible form — letting the chips fall where they may.

The financial tables, which contain the actual details of the rankings, are the heart of ELECTRONIC BUSINESS 200. To complement the tables we again offer rankings by industry segment and by best and worst performances. In addition to the overview article, this year we've added stories on specific aspects of the listing. Rick Whiting writes about perennial No. 1 IBM; Teri Sprackland notes that drive-maker Quantum made the biggest improvement this year; H. Garrett DeYoung describes the problems faced by fast-falling Kollmorgen; Dwight Davis profiles companies that appear on the list for the first time, explains which companies dropped off the list and why, and introduces the newcomer 200th company, board-maker Hadco Corp.

Senior editors Bruce Rayner and Linda Stallmann: Another ELECTRONIC BUSINESS 200 under their belts

The ELECTRONIC BUSINESS 200 is the culmination of a lot of work. Linda spent about nine months collecting, deciphering and analyzing hundreds of annual reports, 10-K filings and press releases, and conducting interviews. She and Bruce deserve a pat on the back for leading this project and compiling this, the only listing of its kind. But they aren't relaxing; now it's time to start on next year's list.

As a service to readers, current and prior versions of the ELECTRONIC BUSINESS 200 are available on disk — both IBM compatible Lotus 1-2-3 and Apple Macintosh Excel versions. The cost for any single year is $100, or $200 for any three years. To order, please phone Jean O'Brien (617-558-4257).

MARVIN GREENE, section editor

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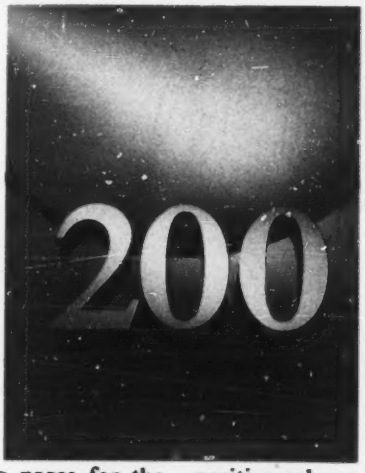
THE ELECTRONIC BUSINESS 200



Take a look back at electronics industry performance in 1989 and what do you see? Sales up a meager 4% — worse performance than during the 1984-85 electronics recession years. If you consider last year's industry inflation rate of 3.9%, sales looked to be at a virtual standstill. After-tax profits were down by nearly 1%; costs jumped by nearly 10%, and prices of many final products dropped sharply thanks to continued strong foreign competition.

Tough times for the industry, yes?

Maybe. But not so very tough. The aggregate numbers only tell part of the story about the industry's achievements of 1989. Regard the details on the following pages for the companies on our list of the largest 200 U.S. electronics companies and a different picture emerges.

True, top-rated IBM saw net income drop an average 10.6% over the past five years, but return on investment at IBM remained strong, at close to 7% last year alone, while return on equity was up a healthy 9.8%.

And the industry's high fliers continued to leap ahead of IBM in financial performance; Apple Computer Inc. saw ROI and ROE come in at 30% last year; Compaq Computer Corp.'s ROI hit 23% last year, with ROE at 28%.

Of course, there were a few big losers last year. Control Data Corp., for example, fell to number 24 on our list from number 19 in 1988. Other poor performers still on the list include Wang Laboratories Inc., National Semiconductor, Data General Corp., Unisys Corp., and Wyse Technologies Inc. But remedial action already has been taken; several will most likely appear in the positive column in next year's list.

In fact, only 18 companies have left the list of the largest companies since 1988, and most of these were merged or otherwise acquired. Poor performance only knocked off a handful. To learn more about these and the 182 other companies on our list of the largest U.S. electronics companies, turn to the pages noted below. □

CONTENTS

44

ELECTRONIC BUSINESS 200 Overview:
1989 was not such a good year after all.

48

THE ELECTRONIC BUSINESS 200:
The main tables.

61

Rankings by industry segments:
Slicing the data.

71

The best and worst performers:
Survival of the fittest.

73

Alphabetical index:
Naming names.

76

The top company:
No surprises from IBM.

81

The 200th company:
Hadco just makes it.

86

The biggest riser:
Quantum leap.

92

The biggest drop:
Kollmorgen tumbles.

98

The new arrivals:
Hail to the 18 risers.

102

The departed:
Gone but not forgotten.

100

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...r, after all. The 200 larges... ...d slow, costs soar and profit...

BY BRUCE C.P. RAYNER AND LINDA STALLMANN

...Both ... per empl... ...BUSINESS 200 compan... ...Revenue per employee rose ... while net income per empl... $6,761. The reason for the ... layoffs. For the ELECTRONIC ... fell by 2% from $.96 ... million at the end of 19...

Top companies, ...

Helping offset ... TRONIC BUSINESS 200 ... billion turnaround ... posted a $1.7 billion ... of a $6.7 billion ... net income of $2... ...gadget, Hewlett-Pa... ...less low in 1988 to $560 million in net income in 19...

For ... ...Over the ... ...

Growth slows for the top 200

age. But even the solid performance of those companies who placed in the top 10 was not enough to boost the overall averages.

Five major companies — Control Data Corp. (No. 24), Data General Corp. (No. 51), National Semiconductor Corp. (No. 43), Unisys (No. 7) and Wang Laboratories Inc. (No. 31) — together managed to lose a whopping $2.051 billion. If these five had broken even, aggregate net income for the ELECTRONIC BUSINESS 200 would have grown by 4.5% instead of dropping by 0.7%. Another sign of tough times was the number of ELECTRONIC BUSINESS 200 companies suffering losses. The figure rose from 3 to 36 in 1989.

Given the cost of equity, debt as a percentage of capital could rise to more than 50%

What went wrong?

The general economic slowdown of the fourth quarter of 1989 contributed to the poor results in the electronics industry last year. Some analysts say that many companies were expecting stronger sales late in the year so they were slow to trim costs. The restructuring that has gripped the industry for the past few years just has not made enough of an impact to get operating costs under control, some say. It is also possible that not enough restructuring has taken place to boost margins.

Slow growth of foreign sales was another factor in the poor showing. Foreign revenue now accounts for 32.3% of total revenue of the ELECTRONIC BUSINESS 200, up from 31.5% in 1988. Growth in foreign sales fell dramatically from 44.3% in 1988 to just 4.8% in 1989. While exchange rate fluctuations account for much of the sluggishness, some forecasters suggest U.S. electronics firms will not be able to rely heavily on foreign sales growth.

This presents problems for a number of leading electronics companies. Thirty-three of the ELECTRONIC BUSINESS 200 companies derive more than 50% of their total revenue abroad. That includes four of the top 10 companies: IBM, DEC, Hewlett-Packard Co. (No. 5) and Motorola Inc. (No. 8). The top foreign supplier is Tandon Computers Inc. (No. 114), which derives 92.3% of its revenue from overseas, mostly in Europe.

While slowing foreign sales are a problem for many electronics companies on this year's list, the biggest concern for ELECTRONIC BUSINESS 200 executives has to be gross margins.

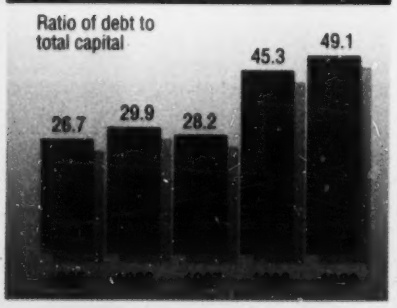
Historically the worst gross margins have been earned in the government, peripherals and electronics distribution sectors. In defense, Lockheed Corp. (No. 18), Northrop Corp. (No. 67) and McDonnell Douglas Corp. (No. 42) all reported gross margins of less than 20% in 1989. Peripheral maker Seagate Technology Inc. (No. 40), Conner Peripherals Inc. (No. 73) and Maxtor Corp. (No. 93) reported gross margins of less than 25%. Likewise, in distribution, Avnet Inc. (No. 44), Arrow Electronics Inc. (No. 63) and Marshall Industries (No. 84) had margins of less than 25%.

There is a silver lining to the industry's cost problems. While gross margins for the top 200 in fiscal year 1989 were off an average of 4.8%, net income declined by only

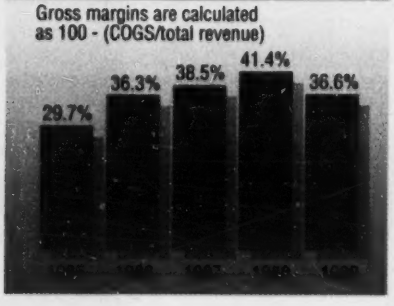
Composite performance of the ELECTRONIC BUSINESS 200

	1985	1986	1987	1988	1989
Electronics revenue ($ billions)	$267.8	$279.2	$299.2	$327.7	$340.8
Total revenue ($ billions)	$797.8	$841.7	$889.7	$774.5	$814.9
Total net income ($ billions)	$35.4	$26.7	$41.0	$39.7	$39.4
WEIGHTED AVERAGES	**1985**	**1986**	**1987**	**1988**	**1989**
Return on equity	11.8%	10.2%	14.1%	13.1%	13.2%
Return on investment	8.7%	7.2%	10.2%	7.2%	6.7%
Cost of goods sold/revenue	70.3%	63.7%	61.5%	58.6%	63.4%
R&D/revenue	4.2%	5.0%	5.2%	5.1%	5.5%
Revenue per employee	$110,800	$102,348	$113,533	$128,756	$133,941
Net income per employee	$5,000	$4,266	$6,662	$6,646	$6,761
5-year compound annual growth					
Revenue	+5.0%	+8.2%	+10.7%	+11.5%	+7.7%
Net income	+1.4%	+4.0%	+13.9%	+8.3%	+3.3%
Capital outlay to net cash flow after dividends	118.3%	97.9%	73.9%	83.8%	95.0%
Debt/total capital	26.7%	29.9%	28.2%	45.3%	49.1%
Foreign sales/total revenue	14.0%	25.4%	24.9%	31.5%	32.3%

Debt on the rise



Gross margins on the decline



0.1%. That means ELECTRONIC BUSINESS 200 companies managed to make up the 4.7% difference in other areas. R&D rose in 1989, so the savings may have come out of administrative, marketing and general costs as well as from restructuring.

Debt rising

A worrisome trend on a different front is companies' growing dependence on debt. Total long-term debt for ELECTRONIC BUSINESS 200 electronics companies rose 14.7% to $182.6 billion in 1989, while short-term debt rose 18.0% to $106.8 billion. Debt as a percentage of total capital rose from 45.3% in 1988 to 49.1% in 1989, the highest level reported since ELECTRONIC BUSINESS began tracking the statistic in 1984. Total capital spending for the ELECTRONIC BUSINESS 200 was $60.6 billion in 1989, an 11.5% increase over 1988.

The situation could well get worse before it gets better. The collapsing junk bond market and persistently high interest rates do not bode well for the industry's cost of debt. Yet there seems to be no easy solution. Debt is increasingly used to finance strategic acquisitions and pay soaring R&D costs. Given the high cost of equity, debt as a percentage of total capital could easily rise to more than 50% in 1990.

Deterioration in other financial statistics follows from rising debt. The average ROI for the ELECTRONIC BUSINESS 200 hit a six-year low in 1989. ROI is calculated as net income divided by the sum of equity plus debt. As the return on equity (ROE) remained fairly constant, it follows that the bulk of the drop in the average ROI was the result of increasing debt. At 6.7%, the average ROI for the ELECTRONIC BUSINESS 200 in 1989 was less than the annual averages of most short-term interest rates: 90-day commercial paper averaged a full two percentage points above the ROI.

Growth in foreign sales fell dramatically from 44.3% in 1988 to just 4.8% in 1989

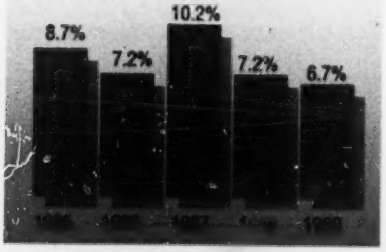
One exception was Premier Industrial Corp. (No. 110), owner of Newark Electronics, a successful electronics distributor. Premier earned 31.8%, the highest ROI in 1989, up from 21.7% in 1988. At the other end of the ranking was Control Data, with a negative 86.1% ROI. Control Data lost $680 million in 1989.

Lower overall ROI and average net income could impede future investment in the U.S. electronics industry. This is reflected in capital outlays as a percentage of net cash flow. Even though the figure rose to 95% in 1989 from 83.8% in 1988, it has been less than 100% now for four years running. As a rule of thumb, anything less than 100% implies a capital base that is not being adequately replaced.

But this traditional measure of capital replacement may no longer be appropriate. The industry has implemented better asset utilization, higher inventory turns and better factory management in the past few years, which means that fewer capital expenditures are necessary to deal with efficiency problems. □

ROI dips again

(aftertax net income as a percentage of equity and debt)



Foreign sales still climbing

Foreign revenue/total revenue

Notes to the ELECTRONIC BUSINESS 200

Revenue

Revenue includes sales of products, services and rentals, but excludes dividends, interest and other non-operating revenue.

Net income

Net income is income from continuing operations after taxes and before extraordinary items.

Return on equity

ROE is net income as a percentage of shareholders' equity (preferred stock, capital stock, surpluses and retained earnings at the company's year-end).

Return on investment

ROI is net income as a percentage of shareholders' equity, plus short-term debt and long-term debt. Short-term debt includes the current portion of long-term debt, notes payable and other borrowings.

Cost of goods sold

COGS includes manufacturing costs of products, services and rentals sold, minus depreciation as a percentage of revenue.

Research and development

R&D is company-sponsored research and development expenses as a percentage of revenue.

Employees

The number of employees is supplied by each company. In most cases this number represents year-end employment.

Capital expenditures to net cash flow

Capital expenditures are measured as a percentage of net income from continuing operations plus depreciation, minus cash dividends paid.

Debt to total capital

This includes long-term and short-term debt as a percentage of shareholders' equity and long- and short-term debt.

Foreign revenue

Foreign revenue includes U.S. operations' export revenue and revenue from operations outside the United States to unaffiliated customers.

Source: Company reports, ELECTRONIC BUSINESS

Rank 1989	Rank 1988	Company	Calendar year 1989: Electronics revenue ($ millions)	Calendar year 1989: Total revenue ($ millions)	Calendar year 1989: Net income ($ millions)	Fiscal year 1989: Total revenue ($ millions)	Fiscal year 1989: Net income ($ millions)	Return on equity	Return on investment
1	1	IBM	$62,710	$62,710.0	$3,758.0	$62,710.0	$3,758.0	9.8%	6.8%
2	2	AT&T	16,586	36,112.0	2,697.0	36,112.0	2,697.0	21.2%	11.6%
3	3	Digital Equipment	12,937	12,936.7	875.8	12,742.0	1,072.6	13.3%	13.1%
4	5	Xerox	12,431	12,431.0	488.0	12,431.0	488.0	8.0%	2.9%
5	6	Hewlett-Packard	12,345	12,345.0	809.0	11,899.0	829.0	15.2%	11.4%
6	4	GM Hughes Electronics	11,359	11,359.0	632.4	11,359.0	632.4	8.0%	7.2%
7	7	Unisys	10,097	10,096.9	-639.3	10,096.9	-639.3	-16.5%	-8.1%
8	9	Motorola	9,620	9,620.0	498.0	9,620.0	498.0	13.1%	9.3%
9	8	General Electric	8,920	54,574.0	3,939.0	40,987.0	3,939.0	18.9%	14.8%
10	11	Texas Instruments	6,522	6,521.9	291.7	6,521.9	291.7	11.7%	9.3%
11	10	Honeywell	6,059	6,058.6	550.3	6,058.6	550.3	28.7%	20.0%
12	12	NCR	5,956	5,956.0	412.0	5,956.0	412.0	20.8%	16.2%
13	17	Apple Computer	5,372	5,372.3	438.4	5,284.0	454.0	30.6%	29.4%
14	13	Raytheon	5,333	8,796.1	528.8	8,796.1	528.8	21.8%	14.5%
15	15	Rockwell International	4,926	12,533.8	720.7	12,797.4	734.9	18.5%	13.9%
16	18	Tandy	4,284	4,283.7	303.9	4,180.7	323.5	18.1%	15.3%
17	14	Eastman Kodak	4,200	18,398.0	529.0	18,398.0	529.0	8.0%	3.1%
18	16	Lockheed	3,830	9,891.0	6.0	9,891.0	6.0	0.3%	0.2%
19	20	Ford Motor	3,500	96,145.9	3,835.0	82,879.4	3,835.0	16.9%	3.5%
20	21	Litton Industries	3,297	5,072.8	179.1	5,022.8	178.3	14.1%	6.1%
21	24	3M	3,297	11,990.0	1,244.0	11,990.0	1,244.0	23.1%	18.5%
22	23	Martin Marietta	3,188	5,796.2	306.9	5,796.2	306.9	22.7%	16.7%
23	25	Intel	3,127	3,126.8	391.0	3,126.8	391.0	15.3%	12.5%
24	19	Control Data	2,935	2,934.5	-680.4	2,934.5	-680.4	-165.3%	-86.1%
25	27	Allied-Signal	2,900	11,942.0	528.0	11,942.0	528.0	15.5%	9.1
26	31	ITT	2,888	20,054.0	922.0	20,054.0	922.0	11.4%	5.6%
27	37	Compaq Computer	2,876	2,876.1	333.3	2,876.1	333.3	28.4%	22.6%
28	26	TRW	2,870	7,340.0	263.0	7,340.0	263.0	15.0%	8.0%
29	29	Westinghouse Electric	2,783	12,844.0	922.0	12,844.0	922.0	21.0%	6.2%
30	36	Harris	2,776	2,776.3	121.6	2,213.6	116.2	12.3%	6.6%
31	22	Varian Laboratories	2,697	2,697.2	-409.6	2,868.8	-320.6	-28.4%	-15.3%
32	34	Boeing	2,420	20,276.0	675.0	20,276.0	675.0	11.0%	10.5%
33	33	AMP	2,377	2,796.6	280.9	2,796.6	280.9	17.3%	14.7%
34	32	DuPont	2,300	35,534.0	2,480.0	35,534.0	2,480.0	15.7%	10.4%
35	35	Emerson Electric	2,190	6,997.6	593.1	7,071.3	588.0	19.1%	15.4%
36	39	GTE	2,140	17,424.4	1,417.3	17,424.4	1,417.3	16.9%	7.0%
37	38	Pitney Bowes	2,120	2,875.7	252.8	2,875.7	180.1	12.6%	4.3%
38	40	Amdahl	2,101	2,101.1	153.0	2,101.1	153.0	13.0%	11.7%
39	44	Sun Microsystems	2,062	2,062.5	36.1	1,765.4	60.8	9.2%	6.6%
40	47	Seagate Technology	1,797	1,797.0	104.7	1,371.6	0.3	0.1%	0.0%
41	46	Tandem Computers	1,677	1,676.8	117.8	1,632.5	118.3	12.0%	10.2%
42	41	McDonnell Douglas	1,650	14,589.0	-37.0	14,589.0	-37.0	-1.1%	-0.5%
43	30	National Semiconductor	1,613	1,612.8	-202.2	1,647.9	-205.5	-24.2%	-22.6%
44	42	Avnet	1,593	1,801.5	63.5	1,933.5	54.0	7.3%	5.7%
45	28	Zenith Electronics	1,549	1,548.9	-17.0	1,548.9	-17.0	-4.3%	-2.9%
46	50	E-Systems	1,457	1,626.4	83.0	1,632.9	83.0	14.8%	12.4%
47	45	Tektronix	1,418	1,418.5	2.9	1,433.0	18.9	3.8%	2.5%
48	52	Varian Associates	1,374	1,373.9	29.7	1,343.6	31.5	7.4%	5.9%
49	51	General Instrument	1,355	1,354.9	87.6	1,304.7	85.5	13.5%	9.8%
50	49	Chrysler	1,300	34,922.0	315.0	34,922.0	315.0	4.4%	0.9%

NA = not available
NM = not meaningful

Fiscal year 1989				Five-year growth (Compounded average annual growth rate)					
Cost of goods as a percentage of revenue	R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
37.4%	10.9%	$163.6	$9.8	6.4%	-10.6%	122.3%	30.3%	58.9%	12/89
36.5%	7.3%	127.4	9.5	1.7%	14.5%	109.4%	45.3%	0.0%	12/89
43.6%	12.0%	101.3	8.5	17.9%	26.7%	69.5%	2.0%	55.1%	6/89
44.0%	6.5%	125.6	4.9	1.7%	10.9%	48.2%	63.7%	46.4%	12/89
47.3%	10.7%	125.3	8.7	14.5%	4.8%	71.1%	25.0%	53.3%	10/89
70.7%	5.2%	124.8	6.9	5.8%	11.4%	77.9%	10.4%	13.5%	12/89
62.2%	7.7%	122.7	-7.8	16.0%	NM	-166.3%	50.5%	49.1%	12/89
54.6%	8.1%	92.5	4.8	11.6%	7.4%	104.3%	28.8%	51.0%	12/89
68.1%	3.3%	140.4	13.5	8.0%	11.6%	55.7%	21.3%	33.9%	12/89
71.1%	7.8%	88.3	3.9	2.6%	1.1%	133.1%	21.0%	31.4%	12/89
64.8%	4.7%	83.4	7.6	9.3%	17.4%	38.2%	30.4%	28.3%	12/89
48.9%	7.5%	106.4	7.4	7.9%	3.7%	69.0%	21.9%	59.0%	12/89
48.6%	8.0%	364.0	31.3	28.4%	47.9%	45.2%	3.7%	35.6%	9/89
76.0%	3.1%	113.4	6.8	8.0%	9.2%	62.2%	33.6%	17.7%	12/89
74.2%	13.3%	117.7	6.8	6.5%	6.2%	58.6%	24.9%	23.5%	9/89
49.6%	0.0%	110.0	8.5	10.9%	3.3%	35.5%	15.7%	3.3%	6/89
53.0%	6.8%	133.6	3.8	11.7%	-10.5%	175.6%	60.7%	44.0%	12/89
95.7%	5.1%	119.9	0.1	4.0%	-55.5%	150.6%	47.6%	12.6%	12/89
85.4%	3.8%	226.1	10.5	9.6%	5.7%	112.8%	79.0%	38.6%	12/89
73.7%	5.4%	99.1	3.5	1.7%	-8.5%	65.2%	56.4%	26.4%	7/89
51.6%	6.5%	136.9	14.2	8.6%	11.2%	83.2%	19.9%	45.8%	12/89
77.4%	3.3%	88.5	4.7	8.1%	1.4%	62.9%	26.2%	0.0%	12/89
47.5%	11.7%	144.1	18.0	13.9%	14.6%	67.2%	18.2%	43.2%	12/89
64.6%	8.5%	163.0	-37.8	-4.5%	NM	-13.0%	47.9%	38.6%	12/89
77.4%	5.0%	111.5	4.9	6.1%	1.6%	79.1%	41.1%	36.0%	12/89
85.8%	2.8%	168.5	7.7	0.5%	15.5%	51.7%	51.3%	28.6%	12/89
56.7%	4.6%	302.7	35.1	54.3%	91.7%	88.0%	20.6%	45.4%	12/89
73.3%	3.5%	98.8	3.5	6.5%	1.1%	81.0%	47.1%	28.0%	12/89
69.5%	1.4%	105.3	7.6	4.6%	11.5%	44.4%	70.4%	20.8%	12/89
61.8%	4.7%	63.1	3.3	5.8%	11.0%	50.2%	46.1%	19.8%	6/89
45.3%	8.5%	98.2	-11.0	5.7%	NM	-360.0%	45.9%	51.1%	6/89
85.3%	3.7%	127.4	4.2	13.9%	-2.1%	131.8%	4.4%	54.4%	12/89
58.5%	9.0%	114.6	11.5	9.1%	6.9%	75.7%	14.9%	54.2%	12/89
48.0%	3.9%	243.7	17.0	-0.4%	11.6%	107.6%	33.6%	53.5%	12/89
62.7%	3.1%	97.4	8.1	9.0%	9.0%	50.3%	19.5%	22.9%	9/89
61.8%	1.6%	110.3	9.0	5.6%	5.4%	106.4%	58.7%	15.9%	12/89
27.5%	3.0%	91.6	5.7	76.4%	45.4%	102.3%	65.9%	23.1%	12/89
54.5%	13.2%	256.2	18.7	21.9%	33.2%	114.4%	10.0%	48.8%	12/89
51.4%	13.3%	172.9	6.0	114.5%	87.0%	125.1%	28.7%	46.5%	6/89
82.0%	3.7%	473.0	0.1	31.9%	-61.1%	91.6%	41.0%	48.2%	6/89
30.2%	12.5%	171.0	12.4	25.1%	22.5%	58.9%	14.3%	29.0%	9/89
80.7%	4.2%	114.0	-0.3	8.6%	NM	224.7%	60.0%	19.9%	12/89
66.5%	16.1%	51.2	-6.4	-0.1%	NM	-301.3%	6.8%	44.9%	5/89
74.5%	0.0%	227.5	6.3	3.4%	-9.1%	34.3%	22.5%	0.0%	6/89
88.4%	3.3%	48.4	-0.5	-2.0%	NM	146.1%	32.3%	9.5%	12/89
82.8%	2.1%	91.1	4.6	15.9%	6.0%	53.5%	16.4%	10.0%	12/89
44.0%	13.2%	91.2	1.2	1.5%	-29.9%	111.2%	33.2%	46.4%	5/89
68.6%	6.2%	111.0	2.6	8.7%	-13.8%	73.3%	20.3%	22.6%	9/89
67.1%	3.6%	82.1	5.4	13.9%	12.8%	53.6%	27.7%	21.0%	2/89
72.4%	2.7%	286.4	2.6	11.2%	-26.7%	117.9%	79.2%	11.9%	12/89

(Continued)

Rank 1989	Rank 1988	Company	Calendar year 1989 Electronics revenue ($ millions)	Calendar year 1989 Total revenue ($ millions)	Calendar year 1989 Net income ($ millions)	Fiscal year 1989 Total revenue ($ millions)	Fiscal year 1989 Net income ($ millions)	Return on equity	Return on investment
51	48	Data General	$1,297	$1,296.5	-$120.7	$1,314.4	-$119.7	-22.9%	-18.1%
52	63	Computer Associates	1,244	1,243.8	145.8	1,030.2	163.5	21.9%	20.1%
53	58	United Technologies	1,220	19,532.1	702.1	19,532.1	702.1	14.8%	8.5%
54	55	Loral	1,156	1,156.4	69.9	1,187.0	60.3	11.6%	5.6%
55	53	General Dynamics	1,135	10,043.0	293.1	10,042.9	293.1	13.8%	8.9%
56	64	SCI Systems	1,133	1,133.3	4.6	986.8	20.9	12.3%	4.6%
57	54	Advanced Micro Devices	1,105	1,104.6	46.1	1,104.6	46.1	6.7%	5.3%
58	65	Johnson Controls	1,032	3,894.0	95.0	3,683.6	97.5	10.0%	6.0%
59	66	Storage Technology	983	982.5	36.4	982.5	36.4	10.8%	5.0%
60	62	Western Digital	977	976.5	14.7	992.1	34.3	11.4%	7.3%
61	73	Microsoft	953	952.8	210.5	803.5	170.5	30.4%	29.0%
62	60	Teledyne	940	3,531.2	150.3	3,531.2	150.3	6.5%	5.2%
63	59	Arrow Electronics	925	925.2	3.2	925.2	3.2	2.2%	1.2%
64	69	General Signal	924	1,918.3	78.5	1,918.3	78.5	15.5%	9.3%
65	61	Grumman	920	3,506.3	67.3	3,558.8	67.3	7.9%	3.7%
66	67	Eaton	900	3,671.0	224.9	3,671.0	209.7	18.3%	10.3%
67	56	Northrop	897	5,248.4	-80.5	5,248.4	-80.5	-9.2%	-4.0%
68	72	Emerson Radio	884	884.2	15.4	761.6	9.6	10.7%	4.5%
69	68	Intergraph	860	860.1	79.5	860.1	79.5	12.6%	12.3%
70	—	Beckman Instruments	786	785.9	41.9	785.9	41.9	15.6%	11.1%
71	71	Cray Research	785	784.7	89.0	784.7	89.0	15.0%	11.3%
72	103	Oracle Systems	769	769.3	97.7	583.7	81.8	35.5%	28.5%
73	154	Conner Peripherals	705	704.9	41.4	704.9	41.4	20.6%	12.6%
74	57	Perkin-Elmer	678	812.6	44.2	784.3	46.9	7.7%	6.2%
75	81	Medtronic	677	797.8	103.2	741.7	97.4	20.6%	17.6%
76	80	LPL Technologies	631	630.5	27.9	630.5	27.9	61.9%	5.3%
77	79	Contel	623	3,114.0	277.0	3,114.0	277.0	16.8%	7.1%
78	78	EG&G	620	1,650.2	69.9	1,650.2	69.9	20.0%	15.1%
79	84	Scientific-Atlanta	585	585.5	39.6	546.8	36.3	14.1%	13.9%
80	82	Molex	579	579.1	62.5	571.9	57.7	13.5%	13.2%
81	88	Lotus Development	556	556.0	68.0	556.0	68.0	24.4%	14.0%
82	105	LSI Logic	547	546.9	-24.9	546.9	-24.9	-8.4%	-4.5%
83	99	Applied Materials	534	534.0	49.1	501.8	51.5	20.2%	17.3%
84	86	Marshall Industries	527	526.6	19.3	533.5	21.4	15.9%	12.0%
85	83	Raychem	506	1,099.0	25.4	1,083.0	36.3	4.9%	4.2%
86	110	Corning	502	2,439.2	259.4	2,439.2	259.4	15.2%	10.9%
87	89	Teradyne	484	483.6	10.2	483.6	10.2	3.5%	3.0%
88	90	AST Research	482	482.0	11.4	456.5	-7.5	-6.9%	-3.9%
89	101	Penn Central	460	1,725.0	174.1	1,725.0	174.1	9.5%	7.9%
90	94	Dover	450	2,120.4	144.0	2,120.4	144.0	19.3%	14.0%
91	87	Wyse Technology	449	449.1	-21.2	452.3	-21.2	-14.5%	-7.6%
92	92	Analog Devices	449	448.9	19.2	453.4	27.9	7.7%	7.2%
93	117	Maxtor	447	447.2	13.9	351.0	5.2	4.1%	2.0%
94	76	Monsanto	440	8,681.0	679.0	8,681.0	679.0	17.2%	11.5%
95	108	Westmark International	439	438.8	19.1	438.8	19.1	7.1%	7.0%
96	116	DSC Communications	430	429.7	34.2	429.7	34.2	13.5%	7.7%
97	130	Novell	429	429.1	52.6	421.9	48.5	20.6%	16.4%
98	97	M/A-COM	427	427.0	-46.9	441.1	0.2	0.1%	0.0%
99	100	United Telecommunications	425	7,549.0	362.9	7,549.0	362.9	17.2%	5.8%
100	91	Atari	424	423.6	4.0	423.6	4.0	4.7%	2.0%

NA = not available
NM = not meaningful

Fiscal year 1989				Five-year growth (Compounded average annual growth rate)					
Cost of goods as a percentage of revenue	R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
45.5%	13.0%	$95.7	-$8.7	2.5%	NM	-503.0%	20.9%	51.0%	9/89
NA	13.0%	164.2	26.1	45.4%	70.6%	9.2%	8.2%	46.3%	3/89
70.6%	4.9%	97.0	3.5	3.4%	1.7%	96.0%	42.7%	33.3%	12/89
57.6%	5.7%	122.4	6.2	23.2%	12.2%	37.3%	52.1%	11.6%	3/89
78.5%	4.6%	98.3	2.9	6.5%	-3.2%	68.4%	35.8%	0.0%	12/89
91.5%	NA	115.0	2.4	17.7%	12.6%	108.9%	62.3%	35.9%	6/89
45.9%	18.3%	84.5	3.5	-0.3%	-22.5%	92.3%	20.6%	48.0%	12/89
80.3%	1.7%	86.5	2.3	20.3%	7.6%	109.6%	39.6%	12.7%	9/89
58.1%	8.7%	105.6	3.9	4.0%	NM	35.3%	53.4%	35.2%	12/89
67.2%	8.7%	152.9	5.3	53.0%	49.9%	49.0%	36.0%	61.6%	6/89
22.4%	13.7%	199.0	42.2	52.5%	60.8%	45.9%	4.3%	54.5%	6/89
75.1%	2.0%	81.7	3.5	0.2%	-23.5%	71.0%	19.9%	10.6%	12/89
77.5%	0.0%	373.8	1.3	5.5%	-25.9%	46.5%	43.3%	0.0%	12/89
68.5%	5.8%	99.0	4.0	1.4%	-6.3%	60.2%	40.2%	27.1%	12/89
88.1%	3.2%	123.1	2.3	6.4%	-9.1%	46.2%	52.6%	6.0%	12/89
70.7%	3.4%	94.8	5.4	4.2%	-2.0%	75.1%	44.0%	28.0%	12/89
85.2%	3.4%	128.0	-2.0	7.3%	NM	223.2%	56.9%	0.0%	12/89
90.4%	0.0%	835.1	10.6	33.2%	-2.6%	50.3%	57.6%	0.0%	3/89
45.6%	10.6%	104.9	9.7	16.3%	4.8%	57.9%	2.7%	37.2%	12/89
43.8%	8.9%	107.9	5.8	8.2%	1.7%	68.8%	28.5%	51.7%	12/89
35.0%	18.3%	166.7	18.9	28.0%	14.4%	51.9%	24.7%	38.2%	12/89
13.3%	9.0%	140.7	19.7	115.0%	125.9%	75.3%	19.8%	48.3%	5/89
76.8%	5.6%	133.1	7.8	NA	NA	117.2%	39.2%	42.7%	12/89
46.1%	7.8%	119.1	7.1	-4.0%	-4.5%	125.2%	19.0%	51.7%	7/89
26.2%	8.9%	117.7	15.5	14.0%	10.2%	40.7%	14.4%	41.7%	4/89
63.0%	2.7%	97.0	4.3	NA	NA	14.4%	91.5%	24.7%	12/89
49.0%	0.0%	142.8	12.7	6.4%	7.2%	130.3%	57.9%	0.0%	12/89
81.6%	1.1%	55.0	2.3	8.2%	4.6%	30.8%	24.5%	6.8%	12/89
64.2%	5.6%	156.2	10.4	6.5%	25.2%	33.5%	1.6%	20.0%	6/89
46.0%	5.2%	91.2	9.2	17.8%	8.6%	86.6%	1.7%	70.9%	6/89
12.8%	17.0%	222.4	27.2	28.8%	13.5%	67.7%	42.5%	77.6%	12/89
60.5%	9.6%	147.8	-6.7	45.3%	NM	166.4%	46.3%	36.9%	12/89
48.9%	14.4%	189.3	19.4	24.4%	30.7%	67.9%	14.7%	65.2%	10/89
75.3%	0.0%	337.2	13.5	16.8%	15.4%	27.4%	24.4%	0.0%	5/89
40.5%	11.1%	94.6	3.2	11.4%	-0.4%	98.6%	15.1%	62.7%	6/89
58.6%	4.5%	88.7	9.4	7.6%	14.2%	94.1%	28.0%	27.0%	12/89
49.9%	13.2%	102.9	2.2	1.3%	-26.2%	64.2%	13.4%	44.9%	12/89
72.9%	3.7%	200.1	-3.3	48.2%	NM	305.2%	42.9%	25.5%	6/89
62.0%	0.0%	114.2	11.5	5.5%	0.5%	20.4%	17.2%	0.0%	12/89
69.7%	2.5%	105.8	7.2	10.5%	7.5%	67.8%	27.4%	21.0%	12/89
75.9%	7.2%	164.0	-7.7	47.6%	NM	-204.3%	47.6%	30.3%	3/89
38.3%	15.2%	87.0	5.3	7.7%	-5.7%	73.6%	5.7%	48.4%	10/89
75.2%	6.7%	NA	NA	84.4%	NM	130.2%	49.6%	20.0%	3/89
50.1%	7.7%	205.8	16.1	5.3%	9.1%	52.9%	33.4%	41.0%	12/89
51.0%	9.8%	126.0	5.5	18.1%	NM	45.5%	1.4%	27.6%	12/89
52.6%	10.2%	129.6	10.3	13.9%	7.7%	81.0%	42.9%	15.0%	12/89
31.3%	10.1%	199.0	22.9	89.1%	164.5%	68.2%	20.2%	34.8%	10/89
64.0%	7.0%	58.3	0.0	-10.5%	-65.8%	117.8%	43.2%	19.4%	9/89
75.2%	0.0%	182.5	8.8	22.0%	9.5%	123.8%	66.2%	0.0%	12/89
72.5%	5.8%	302.6	2.9	NA	NA	85.4%	56.7%	81.9%	12/89

(Continued)

FINANCIAL TABLES: 101-150

Rank 1989	Rank 1988	Company	Calendar year 1989 Electronics revenue ($ millions)	Calendar year 1989 Total revenue ($ millions)	Calendar year 1989 Net income ($ millions)	Fiscal year 1989 Total revenue ($ millions)	Fiscal year 1989 Net income ($ millions)	Return on equity	Return on investment
101	—	Smith Corona	$420	$515.2	$40.9	$493.1	$42.0	28.9%	27.7%
102	159	Vishay Intertechnology	416	415.6	17.8	415.6	17.8	15.1%	5.3%
103	102	Dynatech	415	414.8	10.5	399.5	18.6	12.6%	8.8%
104	126	3Com	414	413.9	25.4	385.9	34.3	16.7%	16.3%
105	111	Eli Lilly	410	4,175.6	939.5	4,175.6	939.5	25.0%	22.6%
106	107	Micron Technology	403	402.5	74.0	446.4	106.1	22.3%	20.1%
107	119	Everex Systems	402	402.0	22.7	377.3	21.3	18.7%	14.9%
108	106	Diebold	399	468.9	36.2	468.9	36.2	9.5%	9.0%
109	196	Quantum	394	394.2	41.3	208.0	12.9	12.9%	12.9%
110	112	Premier Industrial	390	615.8	72.5	602.3	69.7	32.8%	31.8%
111	153	Dell Computer	389	388.6	5.1	338.6	5.1	6.4%	5.4%
112	93	MAI Basic Four	381	381.3	-43.0	396.9	-39.9	-38.4%	-13.6%
113	132	Mentor Graphics	380	380.0	44.8	380.0	44.8	16.3%	15.5%
114	127	Tandon	378	377.9	-4.3	377.9	-4.3	-5.9%	-4.4%
115	115	Reliance Electric	371	1,411.0	33.0	1,411.0	33.0	34.4%	4.4%
116	128	Foxboro	371	597.8	-4.6	597.8	-4.6	-2.5%	-1.6%
117	95	Mark IV Industries	365	912.6	26.0	742.3	22.8	19.9%	2.6%
118	104	LTV	360	6,362.1	264.9	6,362.1	264.9	-5.4%	NM
119	114	Polaroid	350	1,904.7	145.0	1,904.7	145.0	30.8%	10.6%
120	161	Concurrent Computer	345	344.6	-13.3	278.0	-24.7	-65.7%	-10.5%
121	85	Sprague Technologies	344	344.2	-77.9	344.2	-77.9	-35.9%	-26.4%
122	—	Silicon Graphics	343	343.0	20.3	263.8	11.5	7.3%	4.7%
123	146	Stratus Computer	341	341.3	35.4	341.3	35.4	19.2%	16.2%
124	109	Data products	328	327.8	-11.5	353.4	3.8	2.0%	1.9%
125	150	Andrew	320	319.8	17.3	301.9	16.2	8.9%	7.3%
126	125	Cubic	319	354.1	20.5	356.1	17.6	13.6%	9.1%
127	121	Wyle Laboratories	319	415.6	7.5	415.6	7.5	7.9%	5.7%
128	148	Anthem Electronics	319	319.0	15.8	319.0	15.8	16.9%	16.9%
129	135	Watkins-Johnson	311	310.7	18.7	310.7	18.7	12.6%	10.9%
130	123	Applied Magnetics	310	310.4	-20.5	314.1	1.2	0.7%	0.5%
131	134	Pioneer-Standard	308	308.1	4.3	302.3	6.5	16.4%	6.8%
132	113	Micropolis	307	307.3	-49.8	307.3	-49.8	-69.3%	-31.2%
133	120	Avnet	307	306.6	14.9	306.6	14.9	8.0%	7.2%
134	138	Gerber Scientific	306	306.1	33.2	299.3	32.9	18.1%	16.3%
135	165	Ion Industries	300	851.4	33.9	851.4	33.9	10.2%	4.4%
136	141	Sequa	300	1,959.2	60.5	1,959.2	60.5	8.6%	3.6%
137	124	Textron	290	7,440.1	268.7	7,440.1	268.7	10.4%	2.9%
138	171	VLSI Technology	288	288.5	0.5	288.5	0.5	0.3%	0.2%
139	—	Executone	287	287.5	-0.6	287.5	-0.6	-1.2%	-0.5%
140	137	Servo	286	357.5	-45.9	357.5	-45.9	-373.6%	-50.1%
141	147	Measurex	285	285.3	40.7	285.3	40.7	17.7%	17.3%
142	118	Datapoint	282	282.1	-55.8	312.5	-29.6	-21.9%	-12.0%
143	158	Bell	275	1,222.4	35.8	1,222.4	35.8	9.3%	5.1%
144	152	Daisy Manufacturing	275	2,069.2	25.8	2,069.2	25.8	4.3%	1.1%
145	131	Dell Research and Reserves	274	274.1	-34.2	291.6	-31.5	-40.6%	-19.1%
146	163	Ismec	266	265.6	-7.7	249.5	-6.4	-17.7%	-11.5%
147	149	Figgie International	265	1,313.5	62.9	1,337.5	62.9	19.9%	8.8%
148	129	Ashton-Tate	265	265.3	-28.6	265.3	-28.6	-14.5%	-13.9%
149	133	Audiovox	265	293.4	-1.6	293.4	-1.6	-2.4%	-1.4%
150	192	Chips and Technologies	264	264.5	37.4	217.6	33.0	31.4%	28.9%

NA = not available
NM = not meaningful

Cost of goods as a percentage of revenue	Fiscal year 1989 R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Five-year growth (Compounded average annual growth rate) Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
67.1%	1.6%	$102.7	$8.7	13.4%	NM	36.1%	4.3%	28.0%	6/89
64.6%	1.6%	46.2	2.0	53.7%	23.8%	59.4%	64.6%	52.9%	12/89
43.7%	9.8%	138.1	6.4	18.2%	9.6%	44.2%	29.6%	27.8%	3/89
44.1%	9.9%	200.8	17.9	81.0%	113.9%	46.4%	2.2%	38.4%	5/89
24.6%	14.5%	148.1	33.3	6.1%	13.9%	69.6%	9.7%	36.3%	12/89
43.0%	4.8%	144.0	34.2	38.6%	29.6%	137.8%	9.7%	26.3%	8/89
71.6%	5.2%	194.0	10.9	NA	NA	47.8%	20.3%	17.8%	7/89
65.9%	2.9%	112.1	8.7	-0.2%	-8.6%	33.5%	5.9%	12.2%	12/89
69.2%	8.1%	391.7	24.3	25.4%	3.8%	37.2%	0.0%	31.0%	3/89
50.3%	0.5%	125.5	14.5	9.8%	12.7%	22.2%	3.0%	0.0%	5/89
80.3%	5.0%	224.5	3.4	NA	NA	123.9%	16.0%	21.0%	1/90
52.4%	2.5%	107.3	-10.8	6.5%	NM	-43.7%	64.5%	57.4%	9/89
36.7%	13.4%	179.6	21.2	34.0%	40.0%	65.7%	5.2%	48.5%	12/89
77.5%	2.9%	396.1	-4.5	57.6%	NM	326.1%	25.0%	92.3%	12/89
68.4%	5.2%	108.5	2.5	6.0%	29.7%	37.7%	87.3%	10.5%	12/89
63.4%	6.0%	89.9	-0.7	3.0%	NM	175.2%	35.2%	49.9%	12/89
63.9%	2.2%	58.0	1.8	84.4%	65.1%	64.5%	86.9%	20.3%	2/89
84.1%	0.4%	167.4	7.0	-2.0%	NM	87.8%	NM	0.0%	12/89
46.1%	7.2%	166.5	12.7	8.4%	41.3%	47.7%	65.7%	42.7%	12/89
47.4%	11.6%	85.5	-7.6	3.6%	NM	174.9%	84.0%	40.2%	6/89
77.2%	NA	42.0	-9.5	-9.6%	NM	-48.8%	26.6%	49.1%	12/89
45.2%	11.9%	177.9	7.7	117.9%	NM	87.6%	36.4%	39.5%	6/89
33.7%	13.2%	159.0	16.5	51.9%	45.6%	68.4%	15.9%	32.5%	12/89
69.1%	7.4%	101.0	1.1	-2.4%	-32.0%	87.5%	6.3%	27.2%	3/89
59.8%	5.6%	105.2	5.7	6.8%	-4.8%	53.2%	17.5%	42.9%	9/89
70.2%	1.3%	101.7	5.0	5.3%	4.7%	14.6%	33.3%	9.9%	9/89
76.0%	0.0%	192.1	3.5	3.9%	-4.2%	61.5%	28.4%	0.0%	1/90
76.9%	0.0%	614.7	30.4	27.4%	23.6%	49.0%	0.0%	0.0%	12/89
59.7%	6.0%	98.3	5.9	8.1%	-3.1%	45.0%	13.3%	31.8%	12/89
71.5%	8.1%	38.9	0.1	16.6%	-20.1%	191.4%	28.2%	44.2%	9/89
76.2%	0.0%	325.1	7.0	8.8%	13.7%	39.1%	58.7%	0.0%	3/89
93.0%	7.6%	96.1	-15.6	38.6%	NM	-47.8%	54.9%	83.8%	12/89
66.7%	3.6%	105.7	5.1	3.6%	-9.2%	74.1%	10.9%	20.2%	12/89
44.5%	6.7%	146.0	16.0	11.5%	17.5%	26.2%	10.3%	42.5%	4/89
67.2%	1.6%	110.6	4.4	16.8%	13.5%	82.7%	57.3%	29.8%	12/89
72.1%	1.0%	110.7	3.4	44.0%	19.1%	90.1%	57.9%	29.5%	12/89
53.0%	2.7%	128.3	4.6	18.2%	18.8%	61.0%	72.0%	28.1%	12/89
49.2%	16.2%	145.1	0.3	32.9%	-40.1%	101.4%	41.9%	39.9%	12/89
59.3%	2.4%	119.8	-0.3	NA	NA	51.4%	63.2%	0.0%	12/89
67.1%	1.3%	191.2	-24.5	-0.5%	NM	-4.6%	86.6%	12.8%	12/89
54.5%	7.6%	103.0	14.7	12.2%	23.0%	70.8%	2.2%	84.6%	11/89
53.6%	3.6%	127.5	-12.1	-12.2%	NM	-154.0%	45.3%	85.7%	7/89
84.1%	1.0%	170.9	5.0	2.8%	-5.2%	95.7%	45.3%	0.0%	12/89
62.9%	0.6%	54.5	0.7	15.8%	NM	130.7%	74.8%	0.0%	12/89
57.6%	5.4%	103.4	-11.2	22.3%	NM	-355.1%	53.0%	0.0%	6/89
66.1%	0.0%	207.9	-5.3	25.0%	NM	-84.4%	34.8%	53.5%	7/89
69.9%	NA	78.7	3.7	13.2%	29.3%	86.9%	55.5%	0.0%	12/89
11.6%	25.9%	185.5	-20.0	43.9%	NM	357.6%	4.7%	56.7%	12/89
80.0%	0.0%	345.2	-1.8	16.8%	NM	-351.5%	41.9%	0.0%	11/89
47.0%	15.4%	436.9	66.4	NA	NA	13.1%	7.9%	54.4%	6/89

(Continued)

FINANCIAL TABLES: 151-200

Rank 1989	Rank 1988	Company	Calendar year 1989 Electronics revenue ($ millions)	Calendar year 1989 Total revenue ($ millions)	Calendar year 1989 Net income ($ millions)	Fiscal year 1989 Total revenue ($ millions)	Fiscal year 1989 Net income ($ millions)	Return on equity	Return on investment
151	142	CTS	$262	$262.0	$14.3	$262.0	$14.3	11.4%	10.2%
152	144	Cooper Industries	260	5,129.4	267.8	5,129.4	267.8	9.9%	5.6%
153	136	Genicom	257	256.9	-24.3	256.9	-24.3	-70.3%	-16.6%
154	167	Logicon	254	254.2	8.6	232.4	9.6	14.0%	14.0%
155	169	Tyco Laboratories	252	2,100.1	104.7	1,971.1	91.3	18.6%	9.4%
156	168	Olin	251	2,509.0	124.0	2,509.0	124.0	18.6%	9.4%
157	162	Sundstrand	250	1,595.4	120.8	1,595.4	120.8	21.1%	13.0%
158	156	Reynolds and Reynolds	250	594.8	26.3	602.1	27.2	12.3%	7.7%
159	151	Recognition Equipment	249	248.6	35.3	255.9	-38.8	-53.5%	-24.9%
160	173	Dynascan	248	247.7	4.2	247.7	4.2	8.2%	3.8%
161	166	Fluke	247	247.0	23.2	247.7	23.2	21.0%	19.8%
162	143	Bell Industries	247	402.2	5.9	418.2	4.6	4.0%	3.3%
163	139	Square D	245	1,630.5	103.9	1,630.5	103.9	18.7%	10.9%
164	164	Cincinnati Milacron	240	850.6	18.4	850.6	18.4	8.1%	4.4%
165	172	Esterline	238	313.6	8.0	284.2	7.9	12.5%	3.4%
166	177	Thomas & Betts	234	544.1	53.7	544.1	53.7	16.0%	11.2%
167	182	QMS	230	229.9	10.8	215.8	8.2	12.2%	7.5%
168	—	Anacomp	224	641.0	8.7	648.9	9.8	-17.9%	1.8%
169	155	TIE/communications	223	223.1	-69.8	223.1	-69.8	-83.0%	-60.8%
170	—	Symbol Technologies	222	222.3	19.0	222.3	19.0	8.7%	7.9%
171	187	Pittway	220	847.6	32.7	847.6	32.7	8.9%	7.2%
172	178	AM International	220	863.5	22.3	850.6	31.0	12.8%	8.5%
173	194	ADC Telecommunications	217	216.8	19.1	196.4	16.4	14.8%	14.2%
174	170	DCA	213	213.5	34.2	208.2	17.7	8.1%	8.1%
175	184	International Rectifier	207	206.9	-4.7	195.2	-12.7	-76.2%	-7.5%
176	180	Ultimate	207	206.6	2.3	199.9	-15.0	-16.9%	-14.2%
177	122	Kollmorgen	205	227.8	-18.9	227.8	-18.9	-33.4%	-13.3%
178	198	Integrated Device Technology	205	204.9	18.2	180.7	17.9	16.4%	12.4%
179	181	General DataComm Industries	201	201.1	-7.5	201.2	-9.0	-16.3%	-9.4%
180	—	Ametek	200	587.8	38.3	587.8	38.3	19.7%	9.0%
181	—	Cypress Semiconductor	199	199.3	30.7	199.3	30.7	14.0%	13.1%
182	188	Coherent	199	199.2	7.6	201.6	8.6	9.0%	7.9%
183	191	Becton, Dickinson	195	1,834.1	162.8	1,811.5	158.0	14.7%	8.9%
184	175	Cipher Data Products	195	194.8	-21.0	217.8	12.2	7.5%	5.9%
185	140	Dionics	194	194.2	-21.5	194.2	-21.5	-14.0%	-11.1%
186	—	Archive	192	192.5	15.6	181.4	15.3	18.2%	16.0%
187	200	Ask Computer Systems	190	189.6	9.3	186.3	13.5	12.0%	12.4%
188	176	GenRad	189	188.9	-6.1	188.9	-6.1	-10.0%	-4.8%
189	186	San Electric	184	184.4	-8.1	184.4	-8.1	-10.4%	-7.5%
190	—	BancTec	183	183.5	8.9	123.5	7.7	13.2%	7.0%
191	—	Teltrak	181	181.3	7.1	181.3	7.1	5.9%	5.6%
192	185	Flextronics	180	180.4	-23.2	201.9	-11.3	-37.7%	-15.3%
193	—	Teradata	175	175.1	12.6	137.4	9.9	10.1%	8.7%
194	—	Network Equipment	174	174.4	17.5	136.7	16.0	19.1%	16.5%
195	—	Valid Logic Systems	174	173.9	10.0	173.9	10.0	12.1%	9.5%
196	—	Sensormatic Electronics	171	170.7	18.6	150.9	16.7	8.7%	8.0%
197	193	Burr-Brown	169	169.5	8.7	169.5	8.7	10.3%	6.4%
198	—	KLA Instruments	169	168.6	11.1	165.5	11.7	10.5%	9.9%
199	—	Intermec	163	162.7	10.9	131.1	8.0	14.7%	10.5%
200	—	Hadco	162	161.6	7.6	155.8	4.8	10.9%	7.0%

NA = not available
NM = not meaningful

Fiscal year 1989				Five-year growth (Compounded average annual growth rate)					
Cost of goods as a percentage of revenue	R&D as a percentage of revenue	Revenue per employee ($ thousands)	Net income per employee ($ thousands)	Revenue	Net income	Capital outlays to net cash flow after dividends	Debt as a percentage of total capital	Foreign revenue as a percentage of total revenue	Fiscal year ended
75.0%	1.4%	$44.2	$2.4	-1.3%	-5.6%	44.7%	10.9%	23.7%	12/89
63.6%	NA	88.3	4.6	20.4%	20.2%	54.2%	43.6%	27.4%	12/89
72.6%	4.4%	78.8	-7.4	13.5%	NM	-67.8%	76.5%	31.2%	12/89
76.8%	0.9%	91.0	3.8	1.2%	1.2%	31.6%	0.0%	0.0%	3/89
75.0%	0.4%	140.8	6.5	24.8%	24.8%	31.6%	49.3%	0.0%	5/89
72.0%	2.6%	162.9	8.1	6.7%	10.9%	70.0%	49.7%	14.9%	12/89
59.4%	11.4%	116.5	8.8	8.9%	12.7%	48.7%	38.3%	0.0%	12/89
55.2%	1.5%	119.6	5.4	15.7%	9.8%	40.1%	37.7%	11.3%	9/89
63.8%	2.5%	99.2	-15.0	12.8%	NM	-25.2%	53.4%	57.7%	10/89
77.8%	0.6%	605.5	10.2	19.9%	NM	29.0%	53.1%	0.0%	12/89
46.4%	8.3%	103.2	9.6	3.5%	10.0%	32.1%	5.9%	34.7%	9/89
75.9%	0.0%	239.0	2.6	6.0%	-16.6%	53.7%	18.7%	0.0%	6/89
61.3%	3.4%	84.5	5.4	6.4%	-0.4%	86.0%	41.8%	17.7%	12/89
73.6%	3.7%	110.7	2.4	5.2%	-0.3%	142.3%	46.3%	27.1%	12/89
56.9%	6.1%	61.4	1.7	1.7%	-14.1%	44.4%	73.3%	40.3%	10/89
51.3%	3.4%	108.8	10.7	9.1%	6.2%	90.3%	30.2%	43.1%	12/89
63.5%	2.6%	210.1	8.0	38.6%	9.9%	27.0%	38.3%	41.1%	9/89
58.9%	0.7%	86.5	1.3	41.3%	NM	56.8%	110.3%	27.6%	9/89
57.9%	4.1%	191.0	-59.8	-14.9%	NM	-3.6%	26.7%	31.5%	12/89
42.6%	3.5%	123.5	10.5	91.3%	NM	54.1%	9.9%	30.2%	12/89
59.6%	2.4%	97.4	3.8	11.5%	0.6%	109.1%	19.9%	24.6%	12/89
64.2%	2.6%	113.1	4.1	7.3%	27.7%	42.2%	33.3%	42.0%	7/89
49.4%	8.8%	103.6	3.7	17.5%	38.3%	35.4%	4.4%	15.9%	10/89
30.6%	14.3%	143.8	12.2	28.8%	27.8%	18.1%	0.0%	22.3%	6/89
68.8%	3.7%	80.6	-5.2	10.8%	NM	-1054.4%	90.1%	45.3%	6/89
49.7%	2.8%	305.1	-22.9	23.1%	NM	-174.6%	15.8%	37.0%	4/89
64.0%	4.6%	67.0	-5.6	6.3%	NM	-53.5%	60.3%	36.6%	12/89
36.3%	17.1%	96.2	9.6	66.4%	NM	71.7%	24.7%	0.0%	3/89
46.8%	10.8%	88.7	-4.0	13.7%	NM	128.6%	42.2%	36.9%	9/89
71.2%	3.0%	99.6	6.5	13.0%	3.7%	71.0%	54.1%	16.3%	12/89
28.2%	23.9%	143.6	22.1	127.8%	NM	58.2%	6.2%	23.0%	12/89
54.1%	10.5%	121.2	5.1	12.6%	-7.9%	38.4%	12.2%	44.0%	9/89
47.5%	5.4%	96.4	8.4	12.0%	23.7%	130.3%	39.7%	39.6%	9/89
64.7%	9.0%	93.4	5.2	11.7%	-0.3%	30.3%	22.0%	37.6%	6/89
63.3%	8.3%	151.7	-16.8	7.4%	NM	-62.4%	20.6%	56.0%	12/89
62.3%	6.8%	108.8	9.2	36.6%	57.6%	59.7%	12.2%	28.0%	9/89
46.9%	7.2%	232.6	16.8	23.4%	17.0%	11.8%	2.7%	15.1%	6/89
40.3%	14.7%	101.1	-3.3	-3.7%	NM	148.2%	52.3%	50.5%	12/89
54.8%	2.8%	79.3	-3.5	0.9%	NM	-216.9%	27.8%	48.4%	12/89
68.1%	7.2%	63.3	3.9	29.3%	NM	44.2%	47.1%	16.0%	3/89
51.8%	13.1%	90.6	3.5	13.7%	-11.2%	100.0%	3.9%	24.3%	12/89
88.8%	0.0%	65.9	-3.7	49.4%	NM	-127.5%	59.5%	82.0%	3/89
30.5%	13.8%	137.3	9.9	241.5%	NA	103.3%	13.8%	29.2%	6/89
28.9%	11.6%	131.1	15.3	NA	NA	38.0%	13.7%	0.0%	3/89
38.7%	7.5%	178.7	10.3	29.2%	10.5%	47.0%	21.0%	47.5%	12/89
33.8%	2.5%	116.1	12.9	10.0%	-1.7%	22.2%	7.5%	38.4%	5/89
38.6%	10.6%	109.8	5.6	13.8%	12.4%	141.7%	37.5%	68.0%	12/89
51.2%	15.2%	167.0	11.8	31.0%	15.6%	59.1%	5.7%	47.7%	6/89
40.6%	6.3%	119.2	7.3	34.6%	23.4%	92.1%	28.6%	24.0%	3/89
73.5%	0.0%	94.9	2.9	4.5%	-1.4%	40.0%	36.0%	0.0%	10/89

INDUSTRY SEGMENTS

Fiscal 1989 figures Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	200 rank
Computer-based systems								
QMS	$210.1	3.8%	7.5%	63.5%	2.6%	1.7%	41.1%	167
Gerber Scientific	146.0	11.0%	16.3%	44.5%	6.7%	3.4%	42.5%	134
Symbol Technologies	123.5	8.5%	7.9%	42.6%	3.5%	6.3%	30.2%	170
Coherent	121.2	4.2%	7.9%	54.1%	10.5%	3.0%	44.0%	182
Intermec	119.2	6.1%	10.5%	40.6%	6.3%	8.9%	24.0%	199
Perkin-Elmer	119.1	6.0%	6.2%	46.1%	7.8%	7.2%	51.7%	74
Sensormatic Electronics	116.1	11.1%	8.0%	33.8%	2.5%	3.8%	38.4%	196
Diebold	112.1	7.7%	9.0%	65.9%	2.9%	2.1%	12.2%	108
Measurex	103.0	14.3%	17.3%	54.5%	7.6%	8.8%	84.6%	141
Recognition Equipment	99.2	-15.2%	-24.9%	63.8%	2.5%	1.9%	57.7%	159
BancTec	63.3	6.2%	7.0%	68.1%	7.2%	4.8%	16.0%	190
Weighted average	**$116.2**	**5.9%**	**7.1%**	**52.8%**	**5.7%**	**4.9%**	**42.5%**	
Communications								
3Com	200.8	8.9%	16.3%	44.1%	9.9%	6.1%	38.4%	104
TIE/communications	191.0	-31.3%	-60.8%	57.9%	4.1%	1.0%	31.5%	169
Scientific-Atlanta	156.2	6.6%	13.9%	64.2%	5.6%	2.9%	20.0%	79
Digital Communications	143.8	8.5%	8.1%	30.6%	14.3%	2.5%	22.3%	174
Dynatech	138.1	4.7%	8.8%	43.7%	9.8%	4.0%	27.8%	103
Network Equipment	131.1	11.7%	16.5%	28.9%	11.6%	6.9%	0.0%	194
DSC Communications	129.6	8.0%	7.7%	52.6%	10.2%	11.8%	15.0%	96
Datapoint	127.5	-9.5%	-12.0%	53.6%	3.6%	5.0%	85.7%	142
Executone Information	119.8	-0.2%	-0.5%	59.3%	2.4%	1.4%	0.0%	139
Andrew	105.2	5.4%	7.3%	59.8%	5.6%	5.4%	42.9%	125
ADC Telecommunications	103.6	8.4%	14.2%	49.4%	8.8%	4.9%	15.9%	173
Motorola	92.5	5.2%	9.3%	54.6%	8.1%	11.4%	51.0%	8
Tellabs	90.6	3.3%	5.6%	51.8%	13.1%	7.9%	24.3%	191
General DataComm Industries	88.7	-4.5%	-9.4%	46.8%	10.8%	3.9%	36.9%	179
General Instrument	82.1	6.6%	9.8%	67.1%	3.6%	6.3%	21.0%	49
Weighted average	**95.3**	**4.9%**	**8.2%**	**54.8%**	**7.8%**	**9.8%**	**43.8%**	
Components (other than semiconductors)								
AMP	114.6	10.0%	14.7%	58.5%	9.0%	9.0%	54.2%	33
Burr-Brown	109.8	5.1%	6.4%	38.6%	10.6%	16.5%	68.0%	197
Augat	105.7	4.9%	7.2%	66.7%	3.6%	5.9%	20.2%	133
LPL Technologies	97.0	4.4%	5.3%	63.0%	2.7%	1.3%	24.7%	76
Molex	91.2	10.1%	13.2%	46.0%	5.2%	16.4%	70.9%	80
General Instrument	82.1	6.6%	9.8%	67.1%	3.6%	6.3%	21.0%	49
Vishay Intertechnology	46.2	4.3%	5.3%	64.6%	1.6%	5.7%	52.9%	102
CTS	44.2	5.4%	10.2%	75.0%	1.4%	4.1%	23.7%	151
Sprague Technologies	42.0	-22.6%	-26.4%	77.2%	NA	8.0%	49.1%	121
Weighted average	**84.3**	**6.3%**	**8.8%**	**61.4%**	**5.7%**	**8.9%**	**43.9%**	
Consumer								
Emerson Radio	835.1	1.3%	4.5%	90.4%	0.0%	1.0%	NA	68
Dynascan	605.5	1.7%	3.8%	77.8%	0.6%	0.7%	NA	160
Audiovox	345.2	-0.5%	-1.4%	80.0%	NA	0.5%	NA	149
Atari	302.6	0.9%	2.0%	72.5%	5.8%	1.3%	81.9%	100
Tandy	110.0	7.7%	15.3%	49.6%	NA	2.9%	3.3%	16
Zenith Electronics	48.4	-1.1%	-2.9%	88.4%	3.3%	2.2%	9.5%	45
Weighted average	**101.3**	**4.3%**	**9.7%**	**65.2%**	**1.8%**	**2.3%**	**8.5%**	

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INDUSTRY SEGMENTS

Fiscal 1989 figures Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	200 rank
Desktop								
Tandon	396.1	-1.1%	-4.4%	77.5%	2.9%	1.1%	92.3%	114
Apple Computer	364.0	8.6%	29.4%	48.6%	8.0%	4.5%	35.6%	13
Compaq Computer	302.7	11.6%	22.6%	56.7%	4.6%	12.8%	45.4%	27
Dell Computer	224.5	1.5%	5.4%	80.3%	5.0%	4.0%	21.0%	111
AST Research	200.1	-1.6%	-3.9%	72.9%	3.7%	2.6%	25.5%	88
Everex Systems	194.0	5.6%	14.9%	71.6%	5.2%	3.5%	17.8%	107
Silicon Graphics	177.9	4.4%	4.7%	45.2%	11.9%	8.8%	39.5%	122
Sun Microsystems	172.9	3.4%	6.6%	51.4%	13.3%	11.6%	46.5%	39
Wyse Technology	164.0	-4.7%	-7.6%	75.9%	7.2%	4.1%	30.3%	91
Hewlett-Packard	125.3	7.0%	11.4%	47.3%	10.7%	7.2%	53.3%	5
Intergraph	104.9	9.2%	12.3%	45.6%	10.6%	8.6%	37.2%	69
Weighted average	**168.2**	**7.1%**	**13.6%**	**51.1%**	**9.1%**	**7.3%**	**46.1%**	
Distribution								
Anthem Electronics	614.7	4.9%	16.9%	76.9%	NA	2.7%	NA	128
Arrow Electronics	373.8	0.3%	1.2%	77.5%	NA	0.4%	NA	63
Marshall Industries	337.2	4.0%	12.0%	75.3%	NA	1.3%	NA	84
Pioneer-Standard Electronics	325.1	2.2%	6.8%	76.2%	NA	1.1%	NA	131
Avnet	227.5	2.8%	5.7%	74.5%	NA	1.2%	NA	44
Wyle Laboratories	192.1	1.8%	5.7%	76.0%	NA	1.5%	NA	127
Weighted average	**273.9**	**2.4%**	**5.3%**	**75.7%**	**NA**	**1.2%**	**NA**	
Diversified								
IBM	183.6	6.0%	6.8%	37.4%	10.9%	10.2%	58.9%	1
Control Data	163.0	-23.2%	-86.1%	64.6%	8.5%	2.4%	38.6%	24
Varian Associates	111.0	2.3%	5.9%	68.6%	6.2%	3.6%	22.6%	48
NCR	106.4	6.9%	16.2%	48.9%	7.5%	7.1%	59.0%	12
Cubic	101.7	4.9%	9.1%	70.2%	1.3%	1.0%	9.9%	126
Honeywell	83.4	9.1%	20.0%	64.8%	4.7%	4.4%	28.3%	11
Harris	63.1	5.2%	6.6%	61.8%	4.7%	4.5%	19.8%	30
Weighted average	**140.5**	**5.2%**	**6.6%**	**42.6%**	**9.8%**	**9.0%**	**54.1%**	
Government								
GM Hughes Electronics	124.8	5.6%	7.2%	70.7%	5.2%	5.7%	13.5%	6
Loral	122.4	5.1%	5.6%	57.6%	5.7%	3.4%	11.6%	54
SCI Systems	115.0	2.1%	4.6%	91.5%	NA	5.1%	35.9%	56
Varian Associates	111.0	2.3%	5.9%	68.6%	6.2%	3.6%	22.6%	48
Bolt Beranek and Newman	103.4	-10.8%	-19.1%	67.8%	8.4%	9.5%	NA	145
Cubic	101.7	4.9%	9.1%	70.2%	1.3%	1.0%	9.9%	126
Watkins-Johnson	98.3	6.0%	10.9%	59.7%	6.0%	3.8%	31.8%	129
E-Systems	91.1	5.1%	12.4%	82.8%	2.1%	3.5%	10.0%	46
Logicon	91.0	4.2%	14.0%	76.8%	0.9%	1.6%	NA	154
Texas Instruments	88.3	4.5%	9.3%	71.1%	7.8%	13.2%	31.4%	10
Harris	63.1	5.2%	6.6%	61.8%	4.7%	4.5%	19.8%	30
M/A-COM	58.3	0.0%	0.0%	64.0%	7.0%	6.5%	19.4%	98
Weighted average	**100.3**	**4.7%**	**7.2%**	**70.7%**	**5.5%**	**7.0%**	**19.3%**	

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INDUSTRY SEGMENTS

Fiscal 1989 figures Company	Revenue per employee ($ thousands)	Profit as a percentage of revenue	Return on investment	Cost of goods sold as a percentage of revenue	R&D as a percentage of revenue	Capital expenditures as a percentage of revenue	Foreign revenue as a percentage of revenue	200 rank
Instruments & measurement								
KLA Instruments	167.0	7.1%	9.9%	51.2%	15.2%	6.5%	47.7%	198
Hewlett-Packard	125.3	7.0%	11.4%	47.3%	10.7%	7.2%	53.3%	5
Perkin-Elmer	119.1	6.0%	6.2%	46.1%	7.8%	7.2%	51.7%	74
Fluke	103.2	9.3%	19.8%	46.4%	8.3%	4.2%	34.7%	161
Teradyne	102.9	2.1%	3.0%	49.9%	13.2%	5.8%	44.9%	87
GenRad	101.1	-3.2%	-4.8%	40.3%	14.7%	8.1%	50.5%	188
Tektronix	91.2	1.3%	2.5%	44.0%	13.2%	6.0%	46.4%	47
Honeywell	83.4	9.1%	20.0%	64.8%	4.7%	4.4%	28.3%	11
Sun Electric	79.3	-4.4%	-7.5%	54.8%	2.8%	2.8%	48.4%	189
Esterline	61.4	2.8%	3.4%	56.9%	6.1%	2.6%	40.3%	165
Weighted average	**105.0**	**6.8%**	**11.8%**	**52.1%**	**9.0%**	**6.2%**	**45.1%**	
Mainframes								
Amdahl	256.2	7.3%	11.7%	54.5%	13.2%	14.5%	48.8%	38
Cray Research	166.7	11.3%	11.3%	35.0%	18.3%	12.6%	38.2%	71
IBM	163.6	6.0%	6.8%	37.4%	10.9%	10.2%	58.9%	1
Control Data	163.0	-23.2%	-86.1%	64.6%	8.5%	2.4%	38.6%	24
Teradata	137.3	7.2%	8.7%	30.5%	13.8%	14.1%	29.2%	193
Unisys	122.7	-6.3%	-8.1%	62.2%	7.7%	6.1%	49.1%	7
NCR	106.4	6.9%	16.2%	48.9%	7.5%	7.1%	59.0%	12
Weighted average	**153.1**	**3.7%**	**4.5%**	**42.5%**	**10.3%**	**9.4%**	**56.6%**	
Medical								
Diasonics	151.7	-11.1%	-11.1%	63.3%	8.3%	4.8%	56.0%	185
Westmark International	126.0	4.3%	7.0%	51.0%	9.8%	3.2%	27.6%	95
Medtronic	117.7	13.1%	17.6%	26.2%	8.9%	6.9%	41.7%	75
Beckman Instruments	107.9	5.3%	11.1%	43.8%	8.9%	6.4%	51.7%	70
Weighted average	**117.8**	**6.3%**	**9.8%**	**41.0%**	**9.0%**	**5.8%**	**43.8%**	
Minicomputers								
Tandem Computers	171.0	7.2%	10.2%	30.2%	12.5%	8.3%	29.0%	41
Stratus Computer	159.0	10.4%	16.2%	33.7%	13.2%	10.8%	32.5%	123
MAI Basic Four	107.3	-10.1%	-13.6%	52.4%	2.5%	2.2%	57.4%	112
Digital Equipment	101.3	8.4%	13.1%	43.6%	12.0%	9.6%	55.1%	3
Wang Laboratories	98.2	-11.2%	-15.3%	45.3%	3.5%	10.4%	51.1%	31
Data General	95.7	-9.1%	-18.1%	45.5%	13.0%	7.0%	51.0%	51
Concurrent Computer	85.5	-8.9%	-10.5%	47.4%	11.6%	4.6%	40.2%	120
Weighted average	**104.5**	**3.7%**	**5.6%**	**42.9%**	**11.4%**	**9.2%**	**51.5%**	
Office equipment								
Savin	191.2	-12.8%	-50.1%	67.1%	1.3%	0.3%	12.8%	140
Xerox	125.6	3.9%	2.9%	44.0%	6.5%	3.5%	48.4%	4
Smith Corona	102.7	8.5%	NA	67.1%	1.6%	3.6%	28.0%	101
Pitney Bowes	91.6	6.3%	4.3%	27.5%	3.0%	10.4%	23.1%	37
Weighted average	**117.9**	**4.1%**	**3.1%**	**42.3%**	**5.8%**	**4.7%**	**42.5%**	

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INDUSTRY SEGMENTS

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Peripherals								
Seagate Technology	473.0	0.0%	0.0%	82.0%	3.7%	5.7%	48.2%	40
Quantum	391.7	6.2%	12.9%	69.2%	8.1%	3.1%	31.0%	109
Everex	194.0	5.6%	14.9%	71.6%	5.2%	3.5%	17.8%	107
Wyse Technology	164.0	-4.7%	-7.6%	75.9%	7.2%	4.1%	30.3%	91
Western Digital	152.9	3.5%	7.3%	67.2%	8.7%	3.9%	61.6%	60
Conner Peripherals	133.1	5.9%	12.6%	76.8%	5.6%	9.3%	42.7%	73
Archive	108.8	8.4%	16.0%	62.3%	6.8%	7.0%	28.0%	186
Storage Technology	105.6	3.7%	5.0%	58.1%	8.7%	5.1%	35.2%	59
Dataproducts	101.0	1.1%	1.9%	69.1%	7.4%	3.3%	27.2%	124
Micropolis	96.1	-16.2%	-31.2%	93.0%	7.6%	4.2%	83.8%	132
Cipher Data Products	93.4	5.6%	5.9%	64.7%	9.0%	2.6%	37.6%	184
Genicom	78.8	-9.4%	-16.6%	72.6%	4.4%	3.2%	31.2%	153
Applied Magnetics	38.9	0.4%	0.5%	71.5%	8.1%	12.3%	44.2%	130
Maxtor	NA	1.5%	2.0%	75.2%	6.7%	8.3%	20.0%	93
Weighted average	**138.0**	**1.3%**	**2.2%**	**72.4%**	**6.7%**	**5.5%**	**41.9%**	
Semiconductors								
Chips & Technologies	436.9	15.2%	28.9%	47.0%	15.4%	2.3%	54.4%	150
Western Digital	152.9	3.5%	7.3%	67.2%	8.7%	3.9%	61.6%	60
LSI Logic	147.8	-4.6%	-4.5%	60.5%	9.6%	20.9%	36.9%	82
VLSI Technology	145.1	0.2%	0.2%	49.2%	16.2%	13.7%	39.9%	138
Intel	144.1	12.5%	12.5%	47.5%	11.7%	13.5%	43.2%	23
Micron Technology	144.0	23.8%	20.1%	43.0%	4.8%	44.6%	26.3%	106
Cypress Semiconductor	143.6	15.4%	13.1%	28.2%	23.9%	16.5%	23.0%	181
Burr-Brown	109.8	5.1%	6.4%	38.6%	10.6%	16.5%	68.0%	197
Integrated Device Technology	96.2	9.9%	12.4%	36.3%	17.1%	14.7%	NA	178
Motorola	92.5	5.2%	9.3%	54.6%	8.1%	11.4%	51.0%	8
Texas Instruments	88.3	4.5%	9.3%	71.1%	7.8%	13.2%	31.4%	10
Analog Devices	87.0	6.1%	7.2%	38.3%	15.2%	11.3%	48.4%	92
Advanced Micro Devices	84.5	4.2%	5.3%	45.9%	18.3%	14.4%	48.0%	57
International Rectifier	80.6	-6.5%	-7.5%	68.8%	3.7%	3.0%	45.3%	175
National Semiconductor	51.2	-12.5%	-22.6%	66.5%	16.1%	16.6%	44.9%	43
Weighted average	**94.2**	**4.8%**	**7.6%**	**58.0%**	**9.9%**	**13.1%**	**43.6%**	
Software								
Ultimate	305.1	-7.5%	-14.2%	49.7%	2.8%	4.7%	37.0%	176
Ask Computer Systems	232.6	7.2%	12.4%	46.9%	7.2%	1.3%	15.1%	187
Lotus Development	222.4	12.2%	14.0%	12.8%	17.0%	12.4%	77.6%	81
Microsoft	199.0	21.2%	29.0%	22.4%	13.7%	11.1%	54.5%	61
Novell	199.0	11.5%	16.4%	31.3%	10.1%	10.3%	34.8%	97
Ashton-Tate	185.5	-10.8%	-13.9%	11.6%	25.9%	8.4%	56.7%	148
Mentor Graphics	179.6	11.8%	15.5%	36.7%	13.4%	10.3%	48.5%	113
Valid Logic Systems	178.7	5.8%	9.5%	38.7%	7.5%	5.4%	47.5%	195
Computer Associates	164.2	15.9%	20.1%	NA	13.0%	2.2%	46.3%	52
Oracle Systems	140.7	14.0%	28.5%	13.3%	9.0%	13.5%	48.3%	72
Weighted average	**183.6**	**12.1%**	**17.0%**	**17.5%**	**12.7%**	**8.4%**	**49.9%**	

For purposes of comparison, only companies whose electronics revenue constitutes over 70% of total revenue are included

BEST AND WORST PERFORMERS

Revenue per employee

($ thousands)		200
TOP 10		**rank**
Emerson Radio	$835.1	68
Anthem Electronics	614.7	128
Dynascan	605.5	160
Seagate Technology	473.0	40
Chips and Technologies	436.9	150
Tandon	396.1	114
Quantum	391.7	109
Arrow Electronics	373.8	63
Apple Computer	364.0	13
Audiovox	345.2	149
MEDIAN	**$116.5**	
BOTTOM 5		
Zenith Electronics	$48.4	45
Vishay Intertechnology	46.2	102
CTS	44.2	151
Sprague Technologies	42.0	121
Applied Magnetics	38.9	130

Net income per employee

($ thousands)		200
TOP 10		**rank**
Chips and Technologies	$66.4	150
Microsoft	42.2	61
Compaq Computer	35.1	27
Micron Technology	34.2	106
Eli Lilly	33.3	105
Apple Computer	31.3	13
Anthem Electronics	30.4	128
Lotus Development	27.2	81
Computer Associates	26.1	52
Quantum	24.3	109
MEDIAN	**$5.4**	
BOTTOM 5		
Ashton-Tate	$-20.0	148
Ultimate	-22.9	176
Savin	-24.5	140
Control Data	-37.8	24
TIE/communications	-59.8	169

Net income/revenue

(percentage)		200
TOP 10		**rank**
Micron Technology	23.8%	106
Eli Lilly	22.5%	105
Microsoft	21.2%	61
Computer Associates	15.9%	52
Cypress Semiconductor	15.4%	181
Chips and Technologies	15.2%	150
Measurex	14.3%	141
Oracle Systems	14.0%	72
Medtronic	13.1%	75
Intel	12.5%	23
MEDIAN	**4.9%**	
BOTTOM 5		
Recognition Equipment	-15.2%	159
Micropolis	-16.2%	132
Sprague Technologies	-22.6%	121
Control Data	-23.2%	24
TIE/communications	-31.3%	169

Return on investment

(percentage)		200
TOP 10		**rank**
Premier Industrial	31.8%	110
Apple Computer	29.4%	13
Microsoft	29.0%	61
Chips and Technologies	28.9%	150
Oracle Systems	28.5%	72
Smith Corona	27.7%	101
Eli Lilly	22.6%	105
Compaq Computer	22.6%	27
Micron Technology	20.1%	106
Computer Associates	20.1%	52
MEDIAN	**7.2%**	
BOTTOM 5		
Sprague Technologies	-26.4%	121
Micropolis	-31.2%	132
Savin	-50.1%	140
TIE/communications	-60.8%	169
Control Data	-86.1%	24

Return on equity

(percentage)		200
TOP 10		**rank**
LPL Technologies	61.9%	76
Oracle Systems	35.5%	72
Reliance Electric	34.4%	115
Premier Industrial	32.8%	110
Chips and Technologies	31.4%	150
Polaroid	30.8%	119
Apple Computer	30.6%	13
Microsoft	30.4%	61
Smith Corona	28.9%	101
Honeywell	28.7%	11
MEDIAN	**12.1%**	
BOTTOM 5		
Genicom	-70.3%	153
International Rectifier	-76.2%	175
TIE/communications	-83.0%	169
Control Data	-165.3%	24
Savin	-373.6%	140

Debt/total capital

(percentage)		200
TOP 10		**rank**
Anacomp	110.3%	168
LPL Technologies	91.5%	76
International Rectifier	90.1%	175
Reliance Electric	87.3%	115
Mark IV Industries	86.9%	117
Savin	86.6%	140
Concurrent Computer	84.0%	120
Chrysler	79.2%	50
Ford Motor	79.0%	19
Genicom	76.5%	153
MEDIAN	**30.2%**	
BOTTOM 5		
Westmark International	1.4%	95
Quantum	0.0%	109
Anthem Electronics	0.0%	128
DCA	0.0%	174
Logicon	0.0%	154

Five-year revenue growth

(compound average annual)		200
TOP 10		**rank**
Teradata	241.5%	193
Cypress Semiconductor	127.8%	181
Silicon Graphics	117.9%	122
Oracle Systems	115.0%	72
Sun Microsystems	114.5%	39
Symbol Technologies	91.3%	170
Novell	89.1%	97
Maxtor	84.4%	93
Mark IV Industries	84.4%	117
3Com	81.0%	104
MEDIAN	**11.3%**	
BOTTOM 5		
Control Data	-4.5%	24
Sprague Technologies	-9.6%	121
M/A-COM	-10.5%	98
Datapoint	-12.2%	142
TIE/communications	-14.9%	169

Five-year net income growth

(compound average annual)		200
TOP 10		**rank**
Novell	164.5%	97
Oracle Systems	125.9%	72
3Com	113.9%	104
Compaq Computer	91.7%	27
Sun Microsystems	87.0%	39
Computer Associates	70.6%	52
Mark IV Industries	65.1%	117
Microsoft	60.8%	61
Archive	57.6%	186
Western Digital	49.9%	60
MEDIAN	**9.8%**	
BOTTOM 5		
Dataproducts	-32.0%	124
VLSI Technology	-40.1%	138
Lockheed	-55.5%	18
Seagate Technology	-61.1%	40
M/A-COM	-65.8%	98

Foreign revenue/total revenue

(percentage)		200
TOP 10		**rank**
Tandon	92.3%	114
Datapoint	85.7%	142
Measurex	84.6%	141
Micropolis	83.8%	132
Atari	81.9%	100
Lotus Development	77.6%	81
Molex	70.9%	80
Burr-Brown	68.0%	197
Applied Materials	65.2%	83
Raychem	62.7%	85
MEDIAN	**36.0%**	
BOTTOM 5		
Cubic	9.9%	126
Zenith Electronics	9.5%	45
EG&G	6.8%	78
Grumman	6.0%	65
Tandy	3.3%	16

ALPHABETICAL INDEX

Company	Rank
3Com Corp.	104
ADC Telecommunications Inc.	173
Advanced Micro Devices Inc.	57
Allied-Signal Inc.	25
AM International Inc.	172
Amdahl Corp.	38
Ametek Inc.	180
AMP Inc.	33
Anacomp Inc.	168
Analog Devices Inc.	92
Andrew Corp.	125
Anthem Electronics Inc.	128
Apple Computer Inc.	13
Applied Magnetics Corp.	130
Applied Materials Inc.	83
Archive Corp.	186
Arrow Electronics Inc.	63
Ashton-Tate Corp.	148
Ask Computer Systems Inc.	187
AST Research Inc.	88
Atari Corp.	100
American Telephone and Telegraph Co.	2
Audiovox Corp.	149
Augat Inc.	133
Avnet Inc.	44
Ball Corp.	143
Bally Manufacturing Corp.	144
BancTec Inc.	190
Beckman Instruments Inc.	70
Becton, Dickinson and Co.	183
Bell Industries Inc.	162
Boeing Co., The	32
Bolt Beranek and Newman Inc.	145
Burr-Brown Corp.	197
Chips and Technologies Inc.	150
Chrysler Corp.	50
Cincinnati Milacron Inc.	164
Cipher Data Products Inc.	184
Coherent Inc.	182
Compaq Computer Corp.	27
Computer Associates International Inc.	52
Concurrent Computer Corp.	120
Conner Peripherals Inc.	73
Contel Corp.	77
Control Data Corp.	24
Cooper Industries Inc.	152
Corning Inc.	86
Cray Research Inc.	71
CTS Corp.	151
Cubic Corp.	126
Cypress Semiconductor Corp.	181
Data General Corp.	51
Datapoint Corp.	142
Dataproducts Corp.	124
Dell Computer Corp.	111
Diasonics Inc.	185
Diebold Inc.	108
Digital Communications Associates Inc.	174
Digital Equipment Corp.	3
Dover Corp.	90
DSC Communications Corp.	96
DuPont, E.I. De Nemours & Co.	34
Dynascan Corp.	160
Dynatech Corp.	103
Eastman Kodak Co.	17
Eaton Corp.	66
EG&G Inc.	78
Eli Lilly and Co.	105
Emerson Electric Co.	35
Emerson Radio Corp.	68
Esterline Corp.	165
Everex Systems	107
Executone Information Systems Inc.	139
E-Systems Inc.	46
Figgie International Inc.	147
Flextronics Inc.	192
Fluke Mfg. Co. Inc., John	161
Ford Motor Co.	19
Foxboro Co., The	116
General DataComm Industries Inc.	179
General Dynamics Corp.	55
General Electric Co.	9
General Instrument Corp.	49
General Signal Corp.	64
Genicom Corp.	153
GenRad Inc.	188
Gerber Scientific Inc.	134
GM Hughes Electronics Corp.	6
Grumman Corp.	65
GTE Corp.	36
Hadco Corp.	200
Harris Corp.	30
Hewlett-Packard Co.	5
Honeywell Inc.	11
International Business Machines Corp.	1
Imo Industries Inc.	135
Inmac Corp.	146
Integrated Device Technology Inc.	178
Intel Corp.	23
Intergraph Corp.	69
Intermec Corp.	199
International Rectifier Corp.	175
ITT Corp.	26
Johnson Controls Inc.	58
KLA Instruments Corp.	198
Kollmorgen Corp.	177
Litton Industries Inc.	20
Lockheed Corp.	18
Logicon Inc.	154
Loral Corp.	54
Lotus Development Corp.	81
LPL Technologies Inc.	76
LSI Logic Corp.	82
LTV Corp., The	118
M/A-COM Inc.	98
MAI Basic Four Inc.	112
Mark IV Industries Inc.	117
Marshall Industries	84
Martin Marietta Corp.	22
Maxtor Corp.	93
McDonnell Douglas Corp.	42
Measurex Corp.	141
Medtronic Inc.	75
Mentor Graphics Corp.	113
Micron Technology Inc.	106
Micropolis Corp.	132
Microsoft Corp.	61
Minnesota Mining and Manufacturing Co.	21
Molex Inc.	80
Monsanto Co.	94
Motorola Inc.	8
National Semiconductor Corp.	43
NCR Corp.	12
Network Equipment Technologies Inc.	194
Northrop Corp.	67
Novell Inc.	97
Olin Corp.	156
Oracle Systems Corp.	72
Penn Central Corp.	89
Perkin-Elmer Corp., The	74
Pioneer-Standard Electronics Inc.	131
Pitney Bowes Inc.	37
Pittway Corp.	171
Polaroid Corp.	119
Premier Industrial Corp.	110
QMS Inc.	167
Quantum Corp.	109
Raychem Corp.	85
Raytheon Co.	14
Recognition Equipment Inc.	159
Reliance Electric	115
Reynolds and Reynolds Co., The	158
Rockwell International Corp.	15
Savin Corp.	140
SCI Systems Inc.	56
Scientific-Atlanta Inc.	79
Seagate Technology Inc.	40
Sensormatic Electronics Corp.	196
Sequa Inc.	136
Silicon Graphics Inc.	122
Smith Corona Corp.	101
Sprague Technologies Inc.	121
Square D Co.	163
Storage Technology Corp.	59
Stratus Computer Inc.	123
Sun Electric Corp.	189
Sun Microsystems Inc.	39
Sundstrand Corp.	157
Symbol Technologies Inc.	170
Tandem Computers Inc.	41
Tandon Corp.	114
Tandy Corp.	16
Tektronix Inc.	47
Teledyne Inc.	62
Tellabs Inc.	191
Teradata Corp.	193
Teradyne Inc.	87
Texas Instruments Inc.	10
Textron Inc.	137
Thomas & Betts Corp.	166
TIE/communications Inc.	169
TRW Inc.	28
Tyco Laboratories Inc.	155
Ultimate Corp., The	176
Unisys Corp.	7
United Technologies Corp.	53
United Telecommunications Inc.	99
Valid Logic Systems Inc.	195
Varian Associates Inc.	48
Vishay Intertechnology Inc.	102
VLSI Technology Inc.	138
Wang Laboratories Inc.	31
Watkins-Johnson Co.	129
Western Digital Corp.	60
Westinghouse Electric Corp.	29
Westmark International Inc.	95
Wyle Laboratories Inc.	127
Wyse Technology	91
Xerox Corp.	4
Zenith Electronics Corp.	45

IBM stumbled last year, but remains at the top

Is IBM in trouble? With profits down by a third last year, some may think so. But chairman John Akers remains optimistic about 1990

BY RICK WHITING

With 1989 sales of $62.7 billion — nearly four times the electronics sales of AT&T — IBM is in no danger of losing its top position on the ELECTRONIC BUSINESS 200.

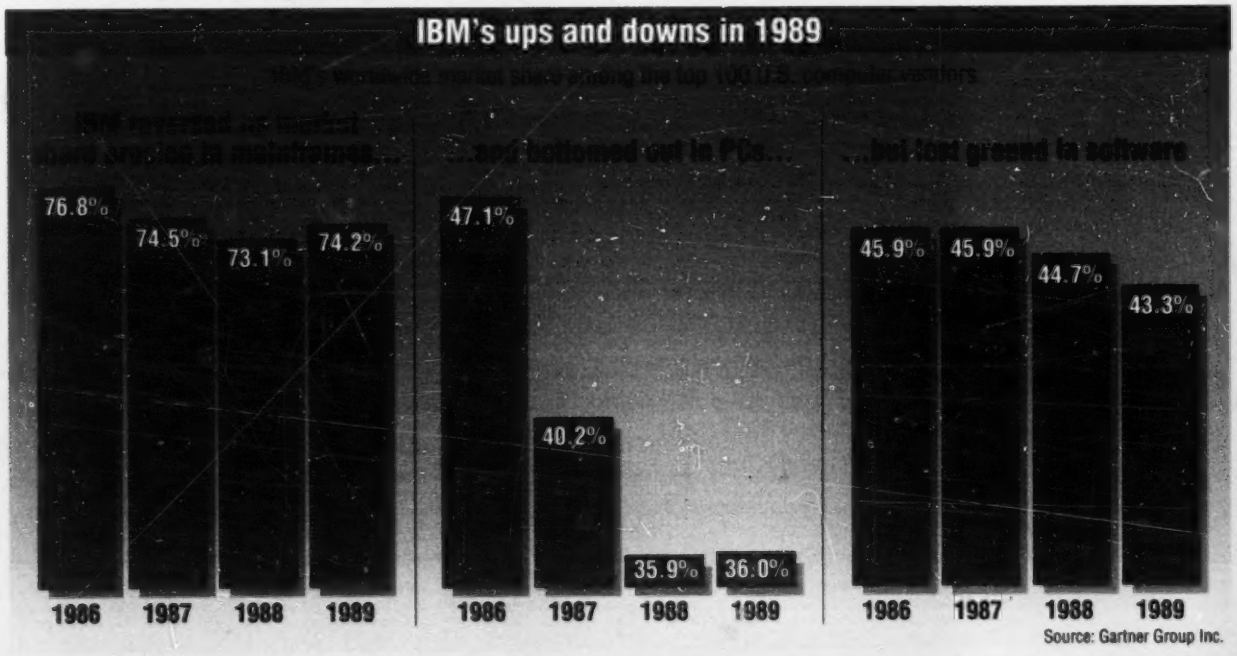
But all is not well at IBM these days. The company's revenue increased a sluggish 5.1% last year over 1988, while its 1989 net income of $3.76 billion represented a 31.6% drop from the previous year. Although international sales did show double-digit growth during the year, domestic sales grew an anemic 1%.

"Our U.S. business, while improving, did not grow as rapidly as expected, and our business as a whole did not live up to our expectations or yours," chairman John F. Akers told stockholders at IBM's shareholders meeting in April. Akers reportedly was more blunt in a January meeting with senior management, where he expressed his unhappiness with efforts to improve the company's performance.

IBM did gain market share in the personal computer and mainframe arenas in 1989, according to Gartner Group Inc.'s "Yardstick" report on the 100 largest U.S. computer vendors. But the company lost ground in the peripherals market and the increasingly important software market. Booming sales of the midrange AS/400 line was one of IBM's few bright spots in 1989.

IBM stumbled technologically as well last year. Early on, manufacturing glitches delayed sales of new high-end PS/2 systems, while semiconductor production snags briefly hurt mainframe sales. Later in the year, manufacturing problems held up shipments of the new 3390 disk drives until November. And the expected fall introduction of the RS/6000 workstation line was delayed until last February, reportedly because of problems with the operating system.

Along with the new product snafus, Akers blamed IBM's lackluster 1989 performance on a stronger dollar and an increase in the number of customer computer leases — which bring in less revenue up front —



Source: Gartner Group Inc.

rather than computer purchases.

Nevertheless, Akers is bullish to stockholders about IBM's future, predicting revenue growth of 7% to 10% a year for the next few years. Signs are the optimism may be based on more than just faith: IBM surprised Wall Street in April by reporting 11.4% revenue growth in this year's first quarter.

Prudential-Bache Securities Inc. analyst Rick Martin believes that 1990 revenue growth will not exceed 7% to 8%. "I don't think they can maintain that pace," he says of the first-quarter results.

To boost its profitability, IBM unveiled a plan last December to consolidate operations and cut 10,000 jobs in the United States through attrition and incentives, bringing U.S. employment down to 206,000 by the end of 1990 and saving an estimated $780 million in annual costs. The company wrote off $2.3 billion in earnings to pay for the program.

Martin points out that those cuts will be phased in slowly throughout this year and the real benefits will not appear on the bottom line until 1991. And Randall Brophy, Gartner Group senior research analyst, believes IBM could stand to lose an additional 20,000 workers to slim down to its fighting weight.

Brophy says IBM must streamline its operations by trimming back its bureaucracy. Akers took steps in that direction in April by naming vice president Stephen B. Schwartz to head up a company-wide effort to cut red tape and eliminate non-essential functions. One observer points to the unwieldy number of people now needed to approve product development projects as a possible target.

Internal debate

A debate is raging within IBM over whether to concentrate on short-term benefits or long-term strategies, according to Marc Butlein, a former IBM executive and chairman of the Westport, Conn.-based Meta Group consulting firm. He points to the decision in March to raise prices on memory and other hardware products. Although that move had the immediate benefit of boosting revenue, "It ultimately affects long-term demand," according to Butlein.

IBM chairman John Akers: Disappointed with his company's performance in 1989

Butlein says the greatest challenge facing IBM is moving away from what he calls its hardware mentality. Although IBM's software offerings constitute one of its major strengths, the consultant believes management has not effectively communicated this to the company's vast sales force. While accounting for $8.4 billion in revenue last year, software sales grew only 6.3% in 1989, compared with 16.0% growth the previous year.

With IBM's new generation of mainframes not expected until later in 1991, Prudential-Bache's Martin expects IBM to face competitive pressures in that market from such rivals as Hitachi Data Systems Corp. this year. And now that the pent up demand for the AS/400 has been met, IBM watchers are projecting slower sales of those computers in 1990.

This year holds more promise for IBM to make gains in the personal computer and workstation markets, despite hot competition from the likes of Compaq Computer Corp. and Sun Microsystems Inc.

In 1989 IBM recorded a slight gain in its share of the PC market, reversing years of steadily eroding market share, according to Gartner Group. And that upward trend should continue this year as PS/2 sales remain strong, Martin believes. "Their PC sales are just going gangbusters."

With a barely detectable share of the workstation market — about 2%, according to market researcher Dataquest Inc. — the only way IBM can go is up. Although some observers are skeptical of the company's stated goal of gaining 15% to 20% of the workstation market, the RS/6000 line unveiled in February does make IBM a serious contender in that arena.

As king of the computer hill, IBM remains the company to beat. The giant manufacturer will continue to do battle with smaller, faster-moving competitors like HDS and Compaq for market share. But IBM also faces challenges from within as it attempts to streamline its operations and determine its long range plans. Its success or failure will determine just how much longer it can stay atop the ELECTRONIC BUSINESS 200.

According to Gartner Group's Brophy: "IBM has a tough road ahead." □

IBM at a glance

Revenue ($ millions)	$62,710	$59,681
Net income ($ millions)	$3,758	$5,491
Net income/sales	6.0%	9.2%
Cost of sales/sales	37.4%	36.5%
R&D/sales	10.9%	9.9%
Marketing, G&A/sales	33.9%	32.4%
Capital expenditures/sales	10.2%	9.0%
Current ratio	1.65	2.03
Debt/equity ratio	0.43	0.34

All figures for fiscal year ended December 31.

Source: Company reports

THE 200TH COMPANY

Hadco's 14% growth is just enough to make the final cut

Claiming to be the largest independent printed circuit board supplier, Hadco points to major capital investments as the key to its success

BY DWIGHT B. DAVIS

Rounding out the ELECTRONIC BUSINESS 200 in the 200th slot is Hadco Corp., the Salem, N.H., manufacturer of complex printed circuit boards. A newcomer to the list, Hadco just made the cut by boosting its revenue from $142.1 million in calendar year 1988 to $161.6 million last year, a 14% gain. Net income rose a whopping 380%, from $2 million to $7.6 million.

These gains are impressive in a business where single-digit growth is the norm. Hadco was able to beat the industry average of about 6% growth, says Jon F. Kropper, president and CEO, in part because it specializes in producing double-sided and multilayer boards.

In recent years, the PC board industry has been demanding more of these types of complex boards and fewer of the low-density, single-sided versions. The growth rate for the multilayer sector, for example, is about 9%, Kropper estimates.

$5 billion market

Figures from the Institute for Interconnecting and Packaging Electronic Circuits (IPC), in Lincolnwood, Ill. support this trend. The 1989 market for rigid PC boards totaled $5.33 billion, says Raymond E. Pritchard, executive director of the industry trade association.

Of that total, single-sided boards accounted for just $389 million, or 7.3%, he says. Double-sided boards accounted for $1.47 billion (27.6%) of the total, and multilayer boards for $3.47 billion (65.1%).

Fully 62% of the total industry sales were made by independent manufacturers such as Hadco, with captive manufacturers accounting for the remainder.

Among the group of 800-plus independents, Hadco claims the No. 1 position. It achieved this rank, Kropper says, largely because of yearly capital investments that average 10% to 12% of sales.

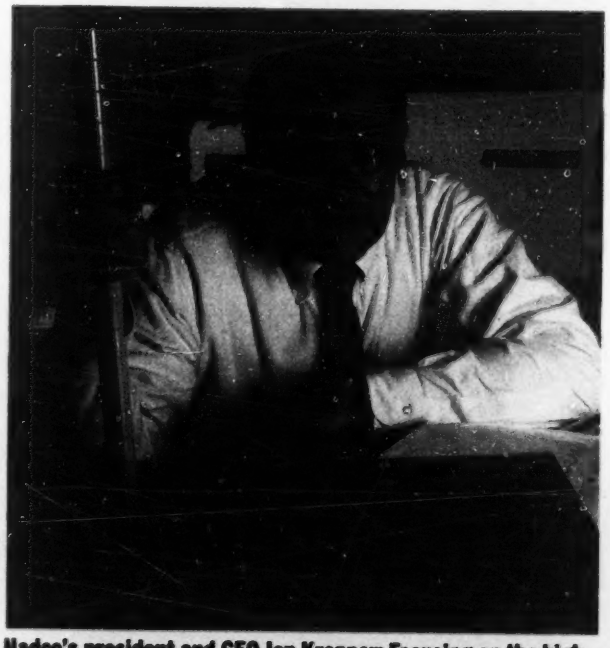
"We've invested $55 million in upgrades since 1985," he says, noting that most of these investments have been aimed at improving product quality. "Quality is the key purchasing factor, and customers are willing to pay 5% to 6% higher prices if the quality is superior," Kropper says.

Prototyping and volume mix

Prototyping new boards for customers accounted for 13% of Hadco's revenue in 1989, and Kropper expects that percentage to grow as product lifetimes shrink. However, the bulk of the firm's business will remain linked to the volume manufacturing of high-end boards for customers such as Digital Equipment Corp., Intel Corp., Sun Microsystems Inc., and Compaq Computer Corp.

Hadco's manufacturing technology can match that of any other independent supplier, Kropper believes, but he admits that the captive manufacturers are the technology leaders in PC boards. "The captives can afford to develop expensive new board technologies as part of the development of new systems," he says. "Then they transfer the technology to us for volume manufacturing."

The biggest constraint on Hadco's continuing growth is the limited availability of "crackerjack technical people and plant managers," Kropper says. "We would end up doing sloppy jobs if we grew too fast." Still, he expects Hadco to reach revenue of $170 million in fiscal 1990. □



Dave Bradley

Hadco's president and CEO Jon Kropper: Focusing on the high end of the PC board market ensures its continued growth

THE BIGGEST RISER

Quantum flies high in the race for disk drive sales

The biggest riser on this year's ELECTRONIC BUSINESS 200 is thriving in a tumultuous market where the competition is so hot several players have gone down in flames

BY TERI SPRACKLAND

Hulks of companies that have crashed and burned while navigating the perilous twists of the disk drive market may litter the landscape, but Quantum Corp. of Milpitas, Calif., seems to be driving straight for success.

In the rough and tumble world of disk drive competition, Quantum, in fact, is navigating its way far above the crowd. In fiscal 1990, profits soared 266%. And the company is earning respect as a sole source for a stellar list of customers.

On this year's ELECTRONIC BUSINESS 200, Quantum shot ahead to 109th from 196th last year — the biggest jump of any company surveyed. In fiscal 1990, ended March 31, Quantum's income statement showed $47.2 million in profits, up 266% from the previous year, on revenue of $446.3 million, up 115%. The company has no bank debt and almost $80 million in cash. Remarkably, productivity per employee is about $585,000. Capacity has tripled to over two million drives per year.

Several years ago, Quantum's executive team decided to get out of 5.25-inch drives and put the company's fortunes into 3.5-inch drives. Stephen M. Berkley, chairman and chief executive, was convinced that the market was not only moving to a smaller form factor, but also switching drive interfaces.

Berkley reasoned that Quantum would have an advantage as the market moved toward Small Computer System Interface (SCSI) — the company had been an early leader in that technology in 1984. So early, in fact, that it had fallen flat on its face when its first SCSI introduction proved to be ahead of its time.

So Quantum picked itself up, jettisoned developments in high capacity 5.25-inch drives and bet the farm that intelligent drive interfaces would catch on by the time the transition to 3.5-inch drives was widespread.

"The disk drive industry is growing 10% to 15% a year. Quantum is growing in excess of 100% a year, which is seven to 10 times as fast as the industry. We're gaining market share because Quantum is extraordinarily well positioned for a major transition now under way in our industry," Berkley says.

Although the shift to smaller drives is well known, the implications of the drive interface shift is not, according to Berkley. In the early to mid '80s, the intelligence of the interface between the CPU and the disk drive was on the main system. The newest generation of PCs and workstations are now being designed to take advantage of the migration to controller functioning on the disk drives.

Focused on high performance

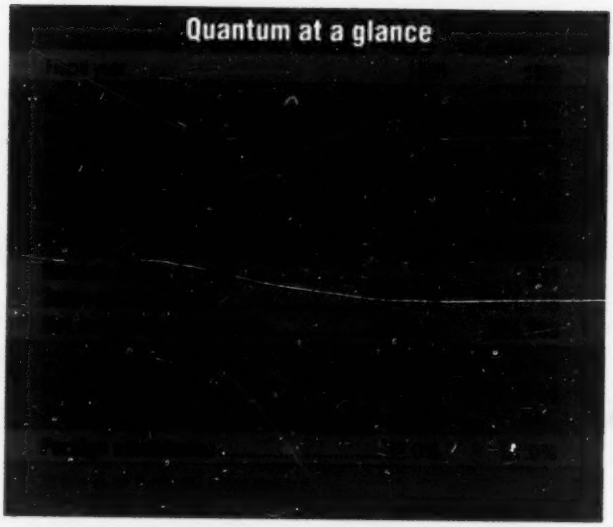
Quantum's current product line is focused on high-performance, high quality memory products for the workstation and high-end personal computer market. In the past, more than half of Quantum's business came from Apple Computer Inc., which used Quantum as a sole source

Cindy Charles

Quantum chairman and CEO Stephen Berkley: Fast growth means cash is available to build a new 37-acre campus

on several key products.

In the past year, Berkley's strategy has been to spread the risk of overdependence on one OEM contract, while keeping an inside track as a sole-source supplier to major customers. Quantum's new account list reads like a "Who's Who" in the systems business. New relationships developed in the last fiscal year include AT&T, Hewlett Packard Co., Intel Corp., NeXT Inc., Sun Microsystems Inc., Unisys Corp., Zenith Electronics Corp., Apricot Computers Ltd. and Victor (in Europe) and Lucky Goldstar (in Korea).



OEMs that have given Quantum sole source agreements on certain drives are Apple, NeXT , Intel, Leading Edge Products Inc. and Sun.

Why is this happening? Berkley ascribes it to the reputation for quality that Quantum protects like the crown jewels. After having lived through the early days of low yields in the peripherals business, Berkley and Quantum cofounder David Brown were determined to do things differently. Quality has become a way of life at Quantum, claims Berkley. "We don't put up banners proclaiming quality programs. We don't have pep rallies." Quality is not expensive, Berkley says. Low yield because of inattention to quality procedures is what really costs.

"We have always emphasized a partnership between design engineering and manufacturing. For our class of products, we believe we are the low-cost producer. We have 500 people in manufacturing producing half a billion dollars of product a year. Manufacturing is highly mechanized but uses simple processes rather than million dollar robotics," Berkley said.

Additionally, although sole sourcing used to be seen as a risky purchasing strategy, times are changing. "The dissipated energy for an OEM to deal with multiple vendors is a waste. It can cost millions of dollars and slow down their time to market. If you have quality vendors who are very responsive to the needs of their customers, and reliable manufacturing, they're way ahead supporting only one vendor," Berkley says.

Several years ago, Quantum decided against expanding its investment in capacity, instead choosing to team with Matsushita-Kotobuki Electronics Industries Ltd. of Japan. Although Quantum has maintained a factory here to make its most advanced products, its high volume products are made by MKE. The Japanese company chose to make the alliance with Quantum to diversify out of its previous business — VCRs. As the VCR market became saturated in the mid-1980s, Matsushita management was seeking another market for high volume manufacturing.

The relationship has been a key element in Quantum's success by controlling manufacturing costs.

Smaller drives, bigger capacity

Looking ahead, Berkley sees continuing progression toward smaller drives to go into markets like laptops. Competition in that race will be keen, especially from Quantum's rival Conner Peripherals Inc., whose close relationship with leading laptop maker Compaq Computer Corp. gives it an edge. Quantum executives acknowledge that they have not been the first to market in some areas, and that lagging behind could be disastrous to any company in the business.

However, a new management structure has been put in place to manage Quantum's growth. Multifunctional teams have responsibility for various segments of the company's chosen market.

"The teams operate like little companies. Engineering, manufacturing, distribution and sales work together. Many of our competitors design a product outside of manufacturing, and throw it over the proverbial wall," according to Berkley. "We've taken lots of arrows and scars, being pioneers. Our priority is to be first to market with new products in our chosen market, and our new program is designed to cut cycle time in half," according to Berkley. Higher capacity and smaller form factors are presently being worked on.

Quantum's success is paying dividends. The company is now well regarded by the financial community. Cash is available now to build a new, 37-acre campus to house 1,500 employees — three times the current number — and support a billion-dollar-a-year Quantum. The buildings will total nearly 600,000 square feet, of which 100,000 square feet will be manufacturing.

A bright future

The future looks bright. Ten new OEM customers in four months, on top of a base of 40 OEMs in the previous 18 months. Distribution sales, mainly through Marshall Industries and Arrow Electronic Inc., are growing very fast, up to 22% of the total sales from 5% a year ago. But Quantum executives are well aware that the disk drive industry has seen many pioneers reap early profits only to die ignominious deaths.

Their plan is in place: the multifunctional management teams, the high productivity per employee, the offloading of high volume manufacturing to its Japanese partner, and a well cultivated and often single-sourced client list. Despite the currently favorable situation, the attitude remains conservative at Quantum. When asked how he intended to keep Quantum on the high road, Berkley responded: "I go home at night, get up and go to work the next day." □

THE BIGGEST DROP

A battered Kollmorgen takes the big fall

If you ignore the attempted takeover, the $117-million drop in sales and the $19-million loss, 1989 might have been a good year for Kollmorgen

BY H. GARRETT DeYOUNG

A little over a year ago, Kollmorgen Corp. seemed to be in the chips. The Simsbury, Conn.-based producer of specialty motors, electro-optical systems and electronic interconnections was basking in the glow of its healthy 1988 sales of $344.8 million (a respectable 14.5% increase over 1987) and was enjoying brisk business, especially in government-related work. Also on the agenda: a lucrative merger with Vernitron Corp. of Deer Park, N.Y., a supplier of motors, controls and magnetic and piezoelectric devices.

What a difference a year makes. Kollmorgen had to kiss off some $7 million in legal and other administrative costs when the proposed merger with Vernitron turned into an unsolicited — and ultimately unsuccessful — takeover attempt.

And the company actually succeeded in intentionally reducing revenue — instead of growing — after selling off its interconnections business, which had generated sales of $97.2 million in 1988.

The restructured company now consists of just two operations:

- Electro-optical instruments, such as submarine periscopes, sighting devices, infrared imaging systems and industrial and scientific instruments. Largely due to the slowdown in defense spending, division sales hit $98 million in 1989, a $21.5-million decline from 1988;
- Motors and controls, including custom high-torque servo motors, electromechanical actuators and associated electronics. With nearly 50% of the division's sales pegged to defense, 1989 revenue rose by a mere $1.8 million or so to reach $129.8 million.

Net result: Kollmorgen's sales last year came in at $227.8 million, a stunning one-year decline of 33.9%. Operating profits also fell from $22.6 million in 1988 to a loss of $8.7 million last year. Kollmorgen took the biggest drop of any company on the ELECTRONIC BUSINESS 200: from No. 122 last year to No. 177 this year.

Don Harry

Kollmorgen vice president James Eder: Even with a 33.9% revenue loss last year, "Our core businesses are basically sound"

Concentrating on the basics

But the company is convinced that its worst times are just about over. "Our core businesses are basically sound," says James A. Eder, vice president and secretary. Kollmorgen's goals now, he adds, are to continue the restructuring process that started late last year with the sale of the interconnections business and seek new ways to cut management and production costs.

Kollmorgen's electronic interconnections business consisted mostly of printed circuit boards, discrete wire circuit boards and the PCK Technology Division, the research arm of the interconnections segment. The discrete wiring operation was sold to Hitachi Chemical last May. Also in May, Kollmorgen announced the sale of patents, technology and other assets of PCK Technology for $12 million, plus the assumption of certain liabilities, to an unidentified buyer. The company also aims to sell off Magnetic Bearings Inc., the majority-owned joint-venture subsidiary (with France's Societe de Mechanique Magnetique) of the motors division.

According to Eder, much of the company's poor showing last year can be attributed to the business

disruptions and customer uncertainty that was associated with the takeover attempt and subsequent litigation. But he also concedes that Kollmorgen was hurt by pure and simple marketplace factors.

Primary customers for the company's motors and controls, for example, include military and aerospace industries and computer and peripheral manufacturers. And while Eder notes that the industrial drives division "is doing OK," he also acknowledges that the operation has been hurt by the slowdown in factory automation. He adds, however, that the company is now moving into several other growing markets, such as machine tools, underwater equipment and medical devices, which include heart pumps, respirators and fitness equipment.

Meanwhile, Kollmorgen's electro-optical business suffered several losses in connection with its military sales, which accounted for 59% of the division's total 1989 sales. Eder attributes the losses to delays in negotiating contract changes on several thermal-imaging programs, as well as to the postponement of other programs. The division has been the U.S. Navy's main designer and supplier of submarine periscopes and spare parts since 1916, according to company sources, and sells the scopes to the navies of other nations as well. Other products of the division include advanced submarine periscopes, developed under a contract for the Defense Advanced Research Projects Agency, and the servo-driven optics for the U.S. Army's Abrams tank.

On the commercial side, the Kollmorgen Instruments Corp. subsidiary supplies spectrophotometers, densitometers and optical systems used for measuring and standardizing color and light in the coatings, textiles and photographic industries. The company blames lower 1989 sales of those particular instruments on the introduction of several of the new products in the division.

Rating the ELECTRONIC BUSINESS 200

A company's standing on the ELECTRONIC BUSINESS 200 is determined by its total sales from electronics products or services. In some cases, a decline in those sales is the direct result of a slippage in the company's overall business. One example is Square D Co., which fell 23 places on the listing because of declines in both total sales and electronic sales. And following the divestiture of one of its imaging businesses, actual revenue at Diasonics Inc. (which relies solely on electronics for sales) dropped from $281.57 million to $198.28 million.

But even a dramatic skid on the ELECTRONIC BUSINESS 200 does not necessarily indicate a bad year for the company. Indeed, several companies on this year's ranking tumbled from their 1989 spots, despite turning in record-breaking sales and profits. Eli Lilly and Co., for example, fell 52 places from last year, although total net sales climbed from $4.07 billion in 1988 to $4.18 billion last year. But sales of electronics (primarily medical instruments) fell from $360 million in 1988, or 8.8% of total sales, to $238 million in 1989, or 5.7% of sales. Similarly, chemical-maker Monsanto Co. slipped 19 places — even though total sales rose from $8.29 billion to $8.68 billion — because electronics sales fell from $647 million to $434 million. □

It is still far too early to predict whether or not Kollmorgen's restructuring will restore the company to its pre-1989 standings. One reason: Vernitron, its erstwhile nemesis. Although Vernitron lost its proxy battle with Kollmorgen's management two months ago, there is no reason to believe that the war is really over. Industry analysts also want to study the "new" Kollmorgen for signs that the company has been able to beef up its marketing and cut its manufacturing costs.

All in all, though, investment analysts are cautiously optimistic about the company. "They're very well-positioned in their niche markets," according to Ellen T. Horing, vice president of Gabelli & Co., a securities broker based in New York City. In motors and controls, she says, the company's involvement in robotics and automation bodes well for the future of both divisions. "And they're doing quite a bit of international business in electro-optics," she adds. "The United States isn't the only country building submarines."

But Horing clearly believes that Kollmorgen is still too dependent on military spending for its sales. Defense, in fact, accounts for nearly 60% of revenue in the electro-optical unit. Nor does she think that Kollmorgen has thus far been nearly bold enough in its restructuring. "I think they should get rid of some more businesses so they can better focus on what they're already doing — making specialty motors and controls," according to Horing. □

Kollmorgen at a glance

Fiscal year	1989	1988
Revenue ($ thousands)	$227,804	$344,787
Net income ($ thousands)	-$18,898	$14,080
Net income/sales	-8.3%	4.1%
Cost of sales/sales	67.8%	67.9%
R&D/sales	4.6%	4.2%
Marketing, G&A/sales	24.3%	21.4%
Number of employees	3,400	3,900
Sales per employee	$67,001	$88,407
Net income per employee	-$5,558	$3,610
Capital expenditures/sales	3.2%	4.6%
Current ratio	1.39	2.14
Debt/equity ratio	1.52	0.82
Foreign sales/sales	36.6%	23.9%

All figures for fiscal year ended December 31. Source: Company reports

Newcomers to this year's ranking are a diverse group

Most of the 18 new arrivals on the ELECTRONIC BUSINESS 200 make the cut through substantial revenue growth, but mergers, spin-offs and IPOs count, too

BY DWIGHT B. DAVIS

Eighteen companies broke into the ELECTRONIC BUSINESS 200 ranks in 1989. They're a diverse lot. The newcomers' lines of business include everything from networking equipment to bar-code readers to word processors.

Most of the 18 made it to the listing through significantly higher revenue growth. Three of the largest, though, arrived via a more circuitous route.

Beckman Instruments Inc. of Fullerton, Calif., appears at the 70th spot courtesy of SmithKline Beckman Corp., which spun off the maker of laboratory instrumentation last year. SmithKline previously owned 84% of the $785.9 million company, and because of the divestiture has fallen from the 200 ranks.

Typewriter and word processor manufacturer Smith Corona Corp. qualified by going public last July. With its established customer base and 1989 calendar year electronics sales of approximately $420 million, the company made it halfway up the ELECTRONIC BUSINESS 200 ladder to No. 101 in its debut appearance.

Executone Information Systems, No. 139, was formed in July 1988 through the merger of Isoetec Communications Inc. and Vodavi Technology Corp., both of which had previously acquired Executone Inc. In 1989, its first full year of operations, the Darien, Conn., manufacturer of voice and data communications equipment posted sales of $287.5 million.

Of the firms that placed through sheer growth, the 122nd ranked company, Silicon Graphics Inc. of Mountain View, Calif., recorded the most impressive gains. The maker of powerful computers and 3D graphics systems increased its revenue 73% from 1988 to 1989, growing from $198.5 million to $343 million. Profits almost doubled during that period, from $10.5 million to $20.3 million.

Silicon Graphics achieved this growth, "by following as well as creating a trend to interact visually with computers," says Mark Perry, executive vice president. Perry calls this interaction "visual processing," and says it is characterized by real-time computing in both color and 3D.

Silicon Graphics' current high-end model can contain up to eight processors and compute at about 250 million instructions per second, but its product line ranges all the way down to the $10,000 Personal Iris system.

"The perception is that we're a high-end niche vendor, but our Personal Iris may cost less than a Macintosh or IBM PC once they're configured to perform an application such as desktop publishing," Perry says.

The "graphics" market is known to be a hot one, but some observers may be surprised to find that the "micrographics" sector of microfilm and microfiche retrieval systems is also strong. Take a look at Anacomp Inc., new on the list at No. 168. The company realized 1989 electronics revenue of about $224 million out of its overall sales of $641.0 million, and has a worldwide customer base of 14,000.

"Five years ago, Anacomp was a very troubled company," admits Louis P. Ferrero, chairman, president and CEO of the Indianapolis firm. In 1985, he says, many analysts thought micrographics was a mature market, and one doomed to erosion by the emerging technology of optical storage media such as CD ROM.

Today, optical storage is a known entity, "and its shortcomings in such areas as standardization and conversion are also known," Ferrero says.

Network Equipment Technologies' chairman and CEO Bruce Smith: The sales practices that tarnished NET's image won't hurt the company's long-term growth

Meanwhile, "micrographics has adapted and moved back into the mainstream of output solutions."

Anacomp's main business is that of computer output microfilm (COM), in which a computer searches microfiche or microfilm files for requested information and then displays it to the user. "Our market is the retrievability of information, and there are many applications that are serial in nature where COM retrieval performance is equal to that of optical disks," Ferrero says.

Not one, but two, bar-code systems companies made their way to the ELECTRONIC BUSINESS 200 listing. Symbol Technologies Inc.'s $222.3 million in sales ranked it 170, and Intermec Corp.'s $162.7 squeaked it on the list at No. 199.

Bar-code systems comprise from 60% to 65% of the $3 billion automatic identification marketplace, which is growing about 25%, says Richard Bravman, vice president of marketing at Bohemia, N.Y.-based Symbol Technologies.

The company once dealt only in bar-code systems, but its November 1988 acquisition of MSI Data Corp. added portable data terminals to the product mix. PDTs are battery-operated, hand-held computers used for data collection and processing. Today, PDTs account for about one-third of Symbol Technologies' sales, with its traditional bar-coding business making up the rest.

For the past few years, bar-code system sales to large, non-food retail customers represented anywhere from 45% to 65% of the firm's sales in any given quarter, Bravman says. "That top tier of customers has now been penetrated for the most part," he explains, so Symbol Technologies is directing its marketing toward mid-range retail chains.

Few if any of the ELECTRONIC BUSINESS 200 have had such a rocky start to 1990 as Network Equipment Technologies Inc., whose 1989 revenue placed it 194th on the list. Long regarded as the rising star of the private networking marketplace, NET stumbled this year when it revealed that improper sales practices by some of its staff had misconstrued orders and inflated revenue and income.

An internal investigation turned up evidence of an invalid September order that resulted in shipments that were never requested. Beyond that particular order, says chairman and CEO Bruce D. Smith, there were a number of immature orders placed which caused NET's factory to build systems that weren't needed or for which customers expected to pay on a long-term basis, rather than immediately.

Because of the improper practices, NET was forced to restate its earnings and income for the final two quarters of calendar year 1989. Calendar year revenue was adjusted downward from $180.3 million to $174.4 million, reducing net income from $20.3 million to $17.5 million.

Even with the adjustment, though, NET's revenue grew 39% from calendar year 1988 to 1989. And while customers and analysts are now jittery about NET's immediate prospects, Smith expects the company to rebound quickly from its problems.

The discovery of the faulty orders "was a monstrous embarrassment," he says, and predicts that the company will operate at a loss or at a break-even level for one or two quarters while it works on placing systems built for specious orders. "But our revenues this year will be bigger than last year's," he says, "and I'll be disappointed if our growth rate isn't something close to 30%."

The relatively new market of optical inspection and analysis has carried KLA Instruments Corp. onto the ELECTRONIC BUSINESS 200 list. In 1989, the Santa Clara, Calif., company sold $168.6 million of its high-speed image processing systems to the semiconductor and interconnect industries, enough to land KLA at the 198th slot.

Like several other semiconductor industry suppliers, KLA has maintained its growth in large part by beefing up its international operations. Five years ago about 85% of the firm's business was with the domestic market; today the domestic/foreign split is close to 50/50, says Robert R. Anderson, chairman and chief financial officer.

Image processing has the advantage of catching flaws early in the production process, unlike the more-established automated-test equipment, which electrically tests finished products for proper operation. "The ATE sector had its heyday 10 to 15 years ago, and optical analysis is just coming into its own," Anderson says.

The growth potential for KLA is bright because the manufacture of more complex semiconductors and circuit boards is difficult to control, Anderson says. "With image processing, manufacturers can catch problems early on, which can have a dramatic effect on the final yield." □

Welcome to the club

Rank 1989	Company	Revenue ($ millions)	Main Business
70	Beckman Instruments	786	Laboratory instruments
101	Smith Corona	420	Word processors, typewriters
121	Silicon Graphics	343	3D workstations, computers
138	Executone Info. Sys.	287	Voice, data communications
165	Anacomp	224	Micrographics systems
171	Symbol Technologies	222	Bar-code, portable terminals
180	Ametek	200	Precision instruments
181	Cypress Semiconductor	199	Semiconductor fabrication
186	Archive	192	Tape drives, subsystems
190	BancTec	183	Financial transaction systems
191	Tellabs	181	Voice, data communications
193	Teradata	175	Database computer systems
194	Network Equip. Tech.	174	Voice, data communications
195	Valid Logic Systems	174	Voice, data communications
196	Sensormatic Electronics	171	Loss prevention systems
198	KLA Instrument	169	Optical inspection equipment
199	Intermec	163	Bar-code systems
200	Hadco	162	Printed circuit boards

Source: ELECTRONIC BUSINESS 200

THE DEPARTED

Gone missing: 18 companies who didn't make the grade

Many of the dearly departed of 1989 were bought off the list of the largest; others left for less savory reasons

BY DWIGHT B. DAVIS

As was the case with the ELECTRONIC BUSINESS 200 last year, the most common way for a company to disappear from the current listing was to be bought off. Fourteen of the 22 departures from last year's listing were acquired; this year's ELECTRONIC BUSINESS 200 has 10 of the 18 exiting companies being purchased.

The other eight "disappeared" companies failed to make the grade for a variety of reasons. Some had slow or negative revenue growth, while a few experienced steep drops in electronics sales due to the sale of key divisions or operations.

Several notable takeovers occurred in 1989 or early 1990 involving both computer systems and software firms. Prime Computer Inc., ranked 43 on last year's ELECTRONIC BUSINESS 200 with revenue of $1.6 billion, was the object of the largest leveraged buy out yet seen in the industry. Apollo Computer Inc., No. 75 last year, was acquired by Hewlett-Packard Co.

On the software front, two independent heavyweights, Management Science America Inc. (No. 157) and Cullinet Software Inc. (No. 174) were also bought up.

Prime buy out time

Prior to its buy out, Prime had waged a nine-month battle to avoid a hostile takeover by MAI Basic Four Inc. Then, last August, DR Holdings Inc. — largely owned by the venture capital and investment firm of J.H. Whitney & Co. of New York — completed a tender offer to acquire 79% of Prime's outstanding common stock for $20 per share. In January, Prime's shareholders approved the completion of the merger, in which DR Holdings paid $22 per share for the remaining Prime shares.

"The Prime LBO went against the traditional wisdom that LBOs only make sense in smokestack America, where the value is primarily a break-up value," says Steven S. Smith, a San Francisco-based partner at merger and acquisition specialist Broadview Associates. He views the massive buy out as "an aberration" not likely to be repeated soon in the electronics industry.

"There aren't many investors willing to put so much of their funds into one deal," he explains.

While some analysts remain dubious about the merit of the Prime LBO, many regard Hewlett-Packard's acquisition of Apollo as a justifiable move through which HP has strengthened its presence in the competitive workstation marketplace. The Palo Alto, Calif., firm paid $13.125 per share, or about $476 million, for Apollo in May 1989.

Hard deals for software

The acquisitions of Management Science America and Cullinet distinguishes this year's ELECTRONIC BUSINESS 200 from last year's, during which no major software acquisitions occurred among the companies ranked. MSA's tenure on the list was short-lived, having appeared for the first time in 1988.

Dun & Bradstreet Corp.'s acquisition of MSA got under way in mid-December, when it purchased about 69% of that company's outstanding shares for $18.50 per share. It completed the deal in early January, when MSA became a wholly owned subsidiary of Dun & Bradstreet following a "short-form" merger. The price of the acquisition was reported to be $333 million.

The Cullinet acquisition, also valued about $300 million, took place in September, when Computer Associates International Inc. of Garden City, N.Y., agreed to pay one half of a share of its stock (priced

Jeffrey Dodge Rogers

LTX Corp.'s chairman and president Graham Miller: "Terrible year for orders, revenues and operating results"

at $16-5/8 on September 11) for each of Cullinet's approximately 36 million common shares. Computer Associates quickly fired about 900 Cullinet employees, and incurred costs of about $30 million in severance and related payments.

Of the remaining acquisitions, one of the more unusual was San Jose-based Maxtor Corp.'s purchase of MiniScribe Corp.'s assets, following MiniScribe's bankruptcy filing. The $41.5 million purchase price consisted of $21.5 million in cash and $20 million of Maxtor stock.

MiniScribe had ended up in bankruptcy court because of accounting irregularities that had grossly inflated the firm's 1988 sales and income. "A company with a significant position in a major market seldom looses it as quickly as did MiniScribe," says Smith at Broadview Associates.

Tough year for ATE

It wasn't takeovers or cooked books that bumped LTX Corp. off this year's ELECTRONIC BUSINESS 200, but a "terrible year for orders, revenues and operating results," says Graham C.C. Miller, chairman and president of the Westwood, Mass.-based maker of automated test equipment for the semiconductor industry. Calendar year sales dropped from $182.2 million in 1988 to $117.7 million in 1989.

Particularly hard hit were the firm's high-end digital VLSI test systems — in fiscal 1989, ended July 31, revenue from digital products fell to $58 million from $88 million the previous year. "We suffered from overbuying in the previous year by the 32-bit microcomputer market, which caused a six- to nine-month hiatus," Miller says. Sales of the firm's linear test equipment only dropped slightly.

LTX also stumbled, Miller admits, "because we were competing to establish ourselves as the largest U.S. digital test supplier, and were driving fast with little backlog. That hurt us, but we're experiencing steadier growth now, and have built our backlog back up."

LTX already has seen some encouraging signs in the current year. It has received large orders from several auto manufacturers and cellular phone suppliers. In addition, purchases by semiconductor customers have grown about 10% per quarter since the end of fiscal 1989, Miller says. As a result, he expects the company to grow back to the $160 million to $170 million range during this calendar year.

Also suffering setbacks in 1989 was Brush Wellman Inc., based in Cleveland. Total revenue fell from $345.8 million in 1988 to $317.8 million last year. Electronics-related sales represent about half of the company's business, resulting in 1989 electronics revenue of just $154 million.

The company supplies high performance engineered materials, with those containing beryllium constituting about 76% of its total sales. Softness in the defense, computer and semiconductor markets hurt 1989 revenue, as did the sale of the firm's cutting-edge business, which had contributed $25 million to the bottom line the previous year.

Declining defense sales also crimped Aydin Corp.'s 1989 operations, as the U.S. government and its defense contractors cut back on purchases of the firm's communications equipment and systems. Sales at the Horsham, Pa., company fell from $169.7 million in 1988 to $157.5 million last year.

A discontinued operation hurt Oak Industries Inc.'s 1989 revenue picture, as the Rancho Bernardo, Calif., company restated the results of operations to reflect its decision to seek a buyer for its communications segment. Revenue at the maker of components for gas and electric appliances dropped from $197.8 million in 1988 to $160.2 million in 1989, of which 92%, or $147 million was electronics related.

The diversified Nashua Corp. of Nashua, N.H., saw its total sales stay flat at $549.3 million from 1988 to 1989. But last year the company sold its international office systems business, which was struggling against increased competition. As a result, electronics revenue for the year fell to about $124 million.

Cherry Corp., also experienced a relatively flat year, with revenue dropping slightly from $210.9 million in calendar year 1988 to $205.9 million in 1989. But because of a restatement of the proportion of its revenue related to electronics, those sales at the maker of electrical switches, electronic keyboards and displays fell from $186 million in 1988 to $144 million last year. □

Gone from the 200...

Rank '89	Company	Acquisitions
43	Prime Computer[1]	[1]Leveraged buy out by DR Holdings, a J.H. Whitney affiliate, in Jan. '90
70	SmithKline Beckman	[2]Acquired by Black & Decker in Apr.'89
74	Emhart[2]	[3]Acquired by Hewlett-Packard in May '89 for $476 million
75	Apollo Computer[3]	[4]Assets acquired by Maxtor for $46 million in Apr. '90
77	Miniscribe[4]	[5]Acquired by Kyocera in Jan. '90
96	Nashua	[6]Acquired by Asea Brown Boveri in Jan. '90 for approx. $160 billion
98	AVX[5]	[7]Acquired by Dunn & Bradstreet in Jan. '90 for $333 million
145	Combustion Engineering[6]	[8]Acquired by BICC in May '89 for $177 million
157	Management Science America[7]	[9]Acquired by Computer Associates International in Sep. '84 for about $300 million
168	BRIntec[8]	[10]Acquired by Banner Industries in Aug. '89 for $400 million
174	Cullinet[9]	
179	Fairchild Industries[10]	
183	Oak Industries	
189	Cherry Electrical Products	
190	LTX	
195	Brush Wellman	
197	Rexon	
199	Aydin	

Source: ELECTRONIC BUSINESS 200

PC makers look to Asia for the next surge in sales

With demand from Asian markets on the rise, PC manufacturers are developing aggressive marketing strategies to prepare for future growth

BY RUSS ARENSMAN

Although AST Research Inc. has manufactured personal computers in Asia since 1985, not much of the company's sales came from the region until recently.

Three years ago the Irvine, Calif., computer company earned less than 5% of its revenue in Asia, says Alex Chu, director of technical services for AST Asia in Hong Kong. But as the PC business has accelerated throughout the region, so has AST's Asian revenue, which grew to more than 10% of the company's $456 million in fiscal 1989 worldwide revenue.

Chu says the company is particularly interested in the fast-growing region that includes the four dragons — Singapore, Hong Kong, Taiwan and South Korea, as well as would-be dragons Thailand and Malaysia.

"We've put a lot of effort into these Asian countries in the past two years," he says. Among other steps, AST has launched an aggressive Hong Kong advertising campaign, expanded its Thai distribution network, and boosted regional marketing and support staff in Hong Kong from a dozen people to more than 30.

Asia: Hot, hot, hot

AST is not alone in taking notice of Asia's growing appetite for PCs. The industry now looks at the region as a promising consumer market, and, even though only about 2% of the world's PCs are installed there so far, it is emerging as one of the industry's hottest growth area.

A few examples include:

- Acer Inc., already the leading name-brand PC vendor in Taiwan with a 20% market share. Much of the company's success in Taiwan has come from sales through its 88 AcerLand computer retail outlets. Now the company is talking with partners elsewhere in the region about opening AcerLand stores outside Taiwan.
- IBM, whose Sydney, Australia-based volume products operation recently introduced in South Korea a low-cost Korean-language PC with a combined processor and monitor. A Chinese-language machine is planned for introduction soon in Taiwan, while local-language products for other markets in the region are under development.
- Advanced Logic Research (ALR) Inc., which is battling Apple Computer Inc. for the No. 2 sales position in Singapore behind IBM. U.S.-based ALR has expanded regional sales, marketing and support staff in Singapore from eight to 45 people since 1988. The company's Asian subsidiary expects to double sales this year to about $30 million.
- NEC, which used an aggressive advertising campaign aimed at corporate users to increase PC unit sales by 45% last year in Hong Kong. The Japanese giant is now running neck and neck with IBM for the top Hong Kong PC vendor position. To emphasize its ability to deliver machines quickly, NEC is keeping an expensive 45-day supply of PCs in inventory.

NCR Hong Kong's manager of marketing services Tony Grandidge: Even in Asia, all the action is at the high end of the PC market

"Very definitely these companies are doing a lot of positioning," says Reid Rasmussen, managing director of ResearchAsia Ltd., a Hong Kong-based technology research firm. "The PC market in this region is growing rapidly, and there are opportunities for PC vendors to take advantage of that."

Precise data on the Asian PC market is difficult to obtain, but Rasmussen estimates that nearly 1.7 million PCs were installed in the six-country region by the end of 1989 — a 50% increase from the previous year.

South Korea growth

U.S.-based researchers International Data Corp., whose Hong Kong Pacific Planning Service tracks computer sales in the region, predicts South Korea will lead the region in PC sales growth this year. IDC forecasts 60% sales growth for Korea in 1990, 42% for Malaysia, 40% for Thailand, 23% for Singapore, 13% for Hong Kong and 11% for Taiwan.

Industry executives agree there are too many dissimilarities between the six countries to permit many generalizations about the overall region's PC market.

"Distances are vast in Asia, and so are the differences in the markets," says John Dutton, managing director of Italian computer maker Ing C. Olivetti & Co.'s regional office in Hong Kong. "The only way you

can address the topic is going country by country."

However, with that in mind, two broad statements can still be made about PC markets in all six countries. First, economic and cultural barriers that have slowed adoption of PC technology throughout Asia are rapidly disappearing. Secondly, small "no-name" manufacturers dominate the market for inexpensive, 8086-based, IBM-compatible PCs; manufacturers in some countries also are making inroads into markets for more sophisticated 80286 and 80386 machines.

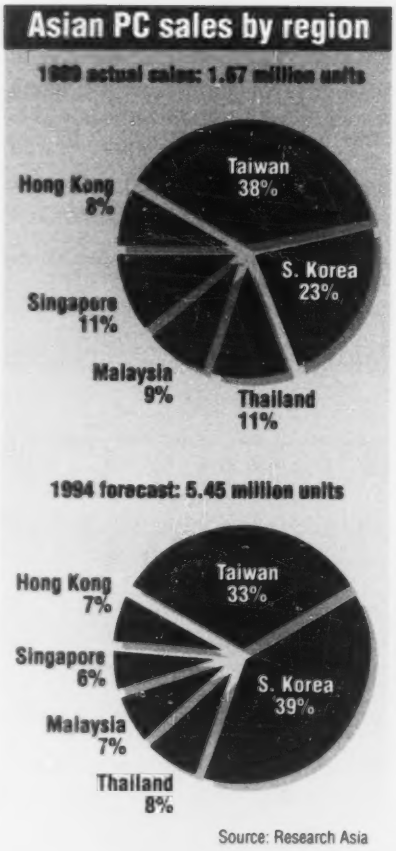
One barrier to sales that is now crumbling is the region's traditionally low wage rates. "Labor costs in these countries have been very low, so the cost for the computer may be higher than to hire more people," says Perry Chan, marketing manager for NEC's Hong Kong subsidiary.

"The cost of labor definitely factors in," agrees ResearchAsia's Rasmussen. "A lot of the arguments you use in terms of productivity just lose their force here." The situation is changing, however, as wages escalate throughout the region. Double-digit annual wage increases are now typical for most of the countries, and a growing number of companies are turning to PCs to boost productivity.

Solving the software problem

Another barrier until a few years ago was scarcity of software, operating systems and keyboards designed to accommodate non-English-language users. Besides the obvious software differences, some languages require fairly sophisticated PC hardware modifications, such as wider data transfer paths, higher-resolution screens and graphics adaptors to handle ideographs such as Chinese characters. Without the complete package, PCs were virtually shut out of markets like Taiwan and South Korea.

The original IBM PC may have come from the United States, but it has found a new home in Asia where thousands of small makers now turn out inexpensive compatibles. The machines tend to be better-accepted in countries where buyers have less money to spend, like Thailand and Malaysia. Conversely, higher-priced, name-brand PCs sell better in Hong Kong and Singapore where there are more corporate buyers.



Source: Research Asia

IDC estimates that as a group, non-brand-name PC manufacturers — meaning those other than the major well-known manufacturers like IBM, Compaq Computer Corp. and Acer — sold substantially more PCs in the region last year than any of the leading major-brand manufacturers. IDC estimates non-branded PCs accounted for a startling 75% of the units sold in Thailand during 1989, followed by 63% in Malaysia, 52% in Taiwan, 28% in Hong Kong, 22% in Singapore and 21% in Korea.

Non-brand producers "pose a big problem for the [name-brand] PC vendors," says Vincent Cheng, IDC country manager for Hong Kong. He says most of the major PC makers cannot compete with prices offered by no-name makers and have simply given up on the low end of the market.

One exception is Olivetti, which has taken direct aim at the Asian market's low end with a new line of low-cost 8086 and 80286-based PCs introduced in Hong Kong this spring, with prices starting at $1,140.

Olivetti's Dutton says the company believes PCs are becoming "true commodity items," like stereos and home appliances, and has designed the new line to be sold through department stores and other non-technical retail outlets.

Most major PC vendors are heading in the opposite direction, however, by discontinuing lower-cost models and focusing on selling more sophisticated systems to large corporate buyers.

Cutthroat low-end market

Tony Grandidge, manager of marketing services for NCR Corp.'s Hong Kong subsidiary, questions whether the low-end business is worth fighting for. "Revenues are one thing, profitability is another. Certainly at the low end of the market we see a very cutthroat market, and one where we do not see many people generating much profitability," he says. "The action is at the high end of the PC market."

Grandidge says the challenge for small manufacturers will be whether they can "go up-market," by developing more sophisticated products like 80386- and 80486-based PCs needed to run local area networks and power-hungry applications like computer-aided design and desktop publishing.

NEC's Chan concedes that some small no-name makers are already selling those machines. But he doubts many buyers will risk spending $10,000 or more for those systems with companies that may not be able to guarantee long-term service and support.

Max Wu, Acer's vice president of marketing, predicts difficult times ahead for many of Taiwan's small no-name PC makers. "I don't see much future for them," he says. "If you just manufacture me-too products, of course you will be shaken out of the market."

The following are a few regional highlights:

- Taiwan. The country boasts one of the region's largest PC industries, with hundreds of domestic manufacturers and an installed base of more than 700,000 machines. The country's PC market is dominated by a handful of large domestic makers, of which Acer is the biggest, accounting for about 20% of the more than 200,000 PCs sold in Taiwan last year.

Other big domestic players include Mitac International Corp., Copam Electronics Corp. and DTC Technology Corp.

• Korea. With a population roughly double Taiwan's, Korea appears a strong candidate to become the region's largest PC market. To date, however, the country has been slow to adopt PCs. An earlier lack of Korean-language systems and restrictions on sales by foreign vendors has combined to limit the country's installed base of PCs to roughly the same size as Taiwan's.

• Hong Kong. As a financial center for many regional corporate headquarters, Hong Kong's PC buyers tend to favor more expensive name-brand machines from foreign buyers. IBM has been Hong Kong's leading PC vendor for several years, but NEC almost caught up in terms of unit shipments last year. Other major vendors include Apple, AST, Toshiba Corp. and Compaq. A survey by Hong Kong's Vocational Training Council reports an installed base of 138,000 PCs in the colony, although several industry officials estimate the actual number is at least 150,000.

• Singapore. Like Hong Kong, Singapore has been a good market for big international PC makers. IBM was the top seller in 1989, but other contenders include Apple, Epson, Acer and ALR, which is partly owned by Singapore's Wearnes Technology. Despite Singapore's population which is half the size of Hong Kong's, analysts say Singapore's modern technical, finance and service sectors have generated a PC market nearly as large as Hong Kong's in both the installed base of PCs and annual sales. □

Tiny memory cards may replace laptop disk drives

A new international standard for high-density plug-in memory modules might result in costs comparable with disk drives

BY CHARLES L. COHEN

Lightweight personal computers — sans disk drives — are about to become truly practical. An international standard is nearing completion for high-capacity RAM and ROM memory cards that can be used to distribute MS-DOS software or for data interchange to users of lightweight notebook and smaller computers not equipped with disk drives.

At present mutually incompatible cards are used in computers from Poqet, Atari Corp., and NEC. Use of the standard card would also provide software publishers with economies of scale and facilitate users' transfer of software.

As a result, use of IC cards for distribution of software will become much more practical. Using 4- and 8-megabit mask ROM chips, an entire 1-megabit card would cost at most $12 to make, and those costs are falling.

Initial standardization efforts were begun in Japan in 1985 by the Japan Electronics Industry Development Association. An ad-hoc group, the Personal Computer Memory Card International Association, was formed in the United States about a year ago and has provided added impetus and fine tuning of the standard. The United States' representatives were most concerned with software compatability, but they did get involved in such hardware issues as the length of connector pins.

The new cards, called PC Cards in the United States, are the size of several credit cards stacked to total 3.3 millimeters thick. They have a 68-pin connector with different length pins for power supply, signals and insertion check. U.S. concerns were directed toward providing a file structure compatible with MS-DOS. Perhaps the most difficult task has been to design the cards for XIP (execute in place), which will allow programs to execute directly from the cards, freeing up precious main memory.

The ROM cards could also be used as font cards in laser printers.

Cards for SRAM-based data (and program) interchange or storage are also part of the standard. The SRAM standard includes write as well as read timing for these cards, which have SRAM chips with battery back up. At $150/MB, the price is much higher than the ROM cards at $12/MB, because the semiconductor cost is extremely high and more chips must be assembled.

Standards for DRAM cards with the same physical dimensions as the now-standard ROM cards should be adopted by September, although the connector could possibly have more pins. Their influence will be felt far outside of the laptop market; they would be money savers in other applications, including desktop computers, laser printers, and facsimile systems.

Key advantages of the new DRAM and PROM cards are the addition of large amounts of memory with virtually no additional space cost to systems, plus easy insertion by relatively unskilled office workers with the same ease as a copier key counter. Although designers in the United States feel that the required sophisticated assembly techniques make for higher costs, Japanese engineers are sure that their drive for *keihaku tansho* (light, thin, short, small) makes for lower prices. □

Component makers fight falling prices, foreign competition

Greater participation in a global standards organization may help U.S. passive component makers compete more effectively

BY GIUSEPPE LABIANCA

The U.S. passive component industry is facing an uphill battle for sales growth both domestically and overseas. This year has been flat so far, with no signs of a recovery until late in the year or early in 1991. Component makers have felt the pinch of the computer and defense industries' slowdown in the United States and are now beginning to feel the effects of a slowdown in growth of foreign sales. There are no quick solutions to the stagnation, but greater participation in a global standards organization could help U.S. component makers compete more effectively.

In the first quarter of 1990, sales by the U.S. electronics industry overall were up 7% from a year ago, while components were up just 3.4%, according to the Electronics Industries Association (EIA). Growth in the $11.6 billion component parts industry in 1989 was up just 3.7%, with some segments posting even lower growth. "Each company has been working harder to keep their market share. They are all pedalling faster just to stay in place," says an EIA official.

A major contributor to the problem is a decline in component prices. Unit sales have increased 3% to 4%, but prices have eroded, leaving total dollar sales flat, says Seth Finkel, vice president of marketing for passive components at distributor Marshall Industries, El Monte, Calif. Pressure on prices results largely from increased foreign competition.

Nearly a quarter of the U.S. passive components market is supplied by foreign sources, according to the Freedonia Group, a Cleveland-based market research firm. Philips of The Netherlands and Japan's Toshiba Corp. are the largest foreign component makers in the U.S. market. Japan's Kyocera Group completed one of the largest acquisitions in the electronics industry last September when it purchased U.S. capacitor maker AVX Corp. for $561 million. Production and procurement of components is increasingly shifting outside of the United States, says William Oakland, director of investor relations for AMP Inc., the Harrisburg, Pa.-based connector manufacturer.

Brad Blankenship, vice president of commercial sensors for Micro Switch, a Honeywell Inc. subsidiary based in Freeport, Ill., believes the worst of the downturn is over for the components industry. Customers' inventory levels are improving from the lows of late-1989, and prices have largely stopped falling, he says.

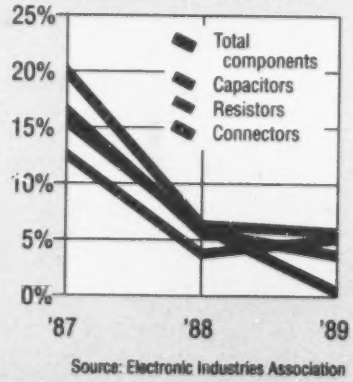
Still, connectors, capacitors, resistors and switches all saw flat sales in 1989 and many manufacturers don't see a turnaround for some time yet. AMP's Oakland says it will be late this year or early next year before the market for connectors recovers. "We're up only 5%, and that came from an acquisition," says Oakland, referring to AMP's November, 1989, acquisition of Garry Screw Machine Corp. New Brunswick, N.J., and Decolletage SA St.-Maurice of Switzerland, which have combined sales of $24 million.

The passive components market should post healthy growth in 1991. Ralph Anavy, president of the Economic Outlook Corp., is forecasting an 11.1% increase in U.S. merchant passive component purchases in 1991, after a 0.1% decrease in 1990.

"I think it will be the fourth quarter of this year before we are finally up over last year," says John Lazlo, vice president and senior technology analyst at Paine Webber Inc. He says that inventories are lean, but OEMs feel inventory levels are appropriate for production levels. Lazlo also sees prices firming up, so any growth in un sales will finally start to show up as revenue increases.

Passives are growing at a snail's pace

U.S. factory sales of electronic component parts, percentage change from previous year



Source: Electronic Industries Association

Foreign connections

Given the slow growth prospects for the U.S. market, many manufacturers and distributors are continuing to look overseas to increase their component sales.

According to Fleck International, a Huntington Beach, Calif.-based market research firm, the North American connector market is forecast to grow 6.1% annually for the next five years from $7.6 billion in 1989 to $10.2 billion in 1994. Comparatively, the five-year annual growth rate will be 6.4% for Japan, 6.6% for Europe and 8.3% for the Pacific Rim. These three markets will account for $13.3 billion by 1994.

U.S. connector manufacturers are looking more toward Europe for sales than Asia. Pamela Gordon, president

of Technology Forecasters, notes a recent study of connector makers conducted by the Berkeley, Calif.-based market research firm which shows that 66.5% of U.S. connector manufacturers' sales are to North America, 21.7% are to Europe, and 10.6% are to Asia.

Jeff Bartlett, director of marketing for AVX/Kyocera in Myrtle Beach, S.C., says that 60% of AVX's sales in 1988 were to the North American market, while 40% were overseas. A year later, overseas sales made up 45% of sales. "In a flat year, we were able to increase our sales by focusing on Europe and the Far East."

But foreign sales are expected to slow, says AMP's Oakland. He says the reason is partly slower GNP growth overseas caused by higher interest rates worldwide. Though growth for components may indeed slow later this year overseas, U.S. companies will continue looking that way rather than face the stiff competition in the flat U.S. component market, adds Oakland.

Certifying component exports

Some U.S. component manufacturers are banding together to support a new standards organization that they believe will increase their competitiveness in the global marketplace by cutting costs and increasing quality. The EIA is seeking to establish a U.S. national certification system, the National Electronics Components Quality Assessment System (NECQ), to allow the U.S. to participate in the International Electrotechnical Commission Quality Assessment System for Electrical and Electronic Components (IECQ).

The IECQ is an international certification system that has existed for eight years and has 24 member nations, including Japan, South Korea, France, Germany and Britain. The EIA is pressing for passive component makers to become active participants in this effort.

"The whole point is to give [U.S. manufacturers] the leg up in the international arena, especially in Europe," says Jack Wyatt, director of technical programs at the EIA's Component Group in Washington. With this system in place, components certified in one member country are acceptable in all other participating nations without the need for further inspection or testing. "If our guys let the NECQ fail, then their only hope of participation in the European market will be to locate a facility there because they will not be able to export IECQ-certified products to Europe from their U.S. plants."

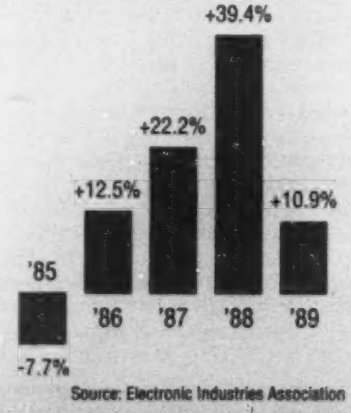
Under the proposed system, component makers would make their products and manufacturing sites available for third-party certification by an inspectorate. The inspectorate would be run by Underwriters' Laboratories. Upon certification, the manufacturers' products are listed on an international Qualified Products List available to equipment manufacturers and users worldwide.

Wyatt says there are many advantages to joining an international certification system. Equipment manufacturers will save on costs by reducing or eliminating incoming inspection of components and site visits to manufacturing sites. Equipment users will have the ability to acquire spare parts from certified multiple sources. Component distributors can gain unbiased approval of their stock and distribution facilities. Component manufacturers will be able to reduce their product lines through the use of common specifications, while also reducing the redundant assessments which are currently conducted on their products and sites by numerous customers.

AVX/Kyocera's Bartlett says that as a large manufacturer with operations in North America, Europe, and the Far East, AVX/Kyocera is very interested in seeing the United States join the IECQ. "It allows us to manufacture components that can be designed anywhere in the world. It also keeps us from proliferating the number of products we have to offer, so we'll be able to keep costs down," says Bartlett.

Export growth slows...

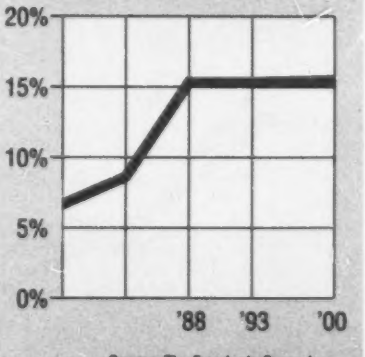
U.S. exports of component parts, percentage change from year ago



Source: Electronic Industries Association

...and the future looks flat for passives exports

U.S. exports of passive components as a percentage of shipments



Source: The Freedonia Group Inc.

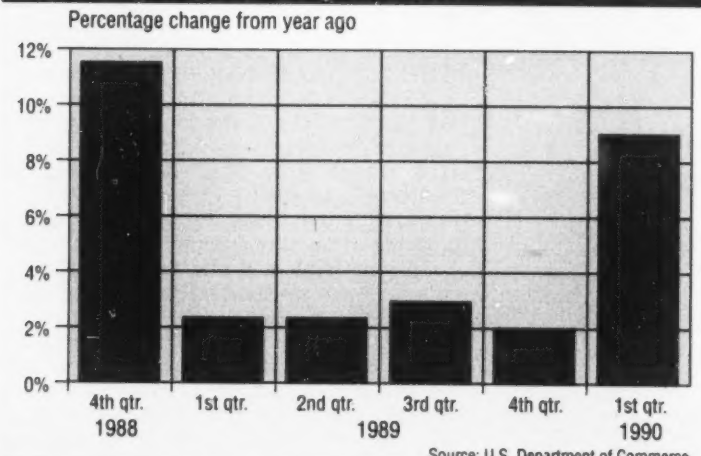
Seeking a TQM culture

Chuck Packard, chairman of the NECQ transition team and a consultant at Unisys Corp., notes that the system in the United States will include proactive certification teams. Rather than simply rejecting or accepting a product or site, the certification teams will train manufacturers in Total Quality Management (TQM) techniques. "The teams will be trying to help the component makers produce defect-free products," says Packard. The introduction of a TQM culture to small U.S. component manufacturers will increase their competitiveness in the global marketplace.

The EIA is already running a pilot program for inspection and certification in the microcircuits industry. "The switch industry is the next product area which we're trying to include in our program," says Robert Geiseman, vice chairman of the NECQ transition team and agency specialist at Micro Switch. Eventually all components will be covered by the NECQ.

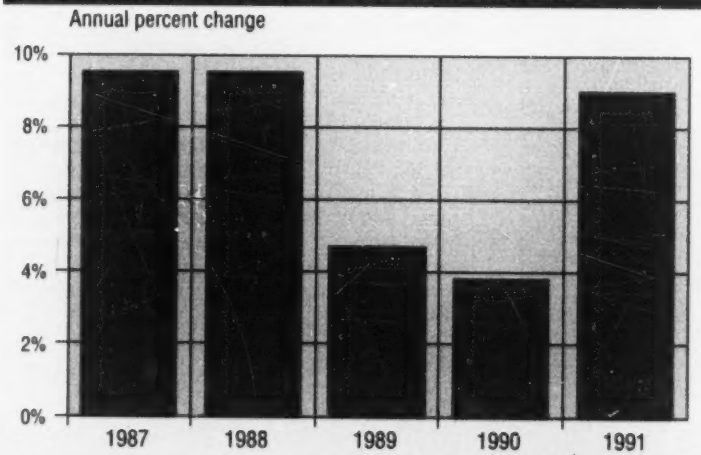
The EIA is sponsoring a symposium for the components industry in Washington on September 18-19 to explain the NECQ and provide further information. □

New orders growth shoots up...



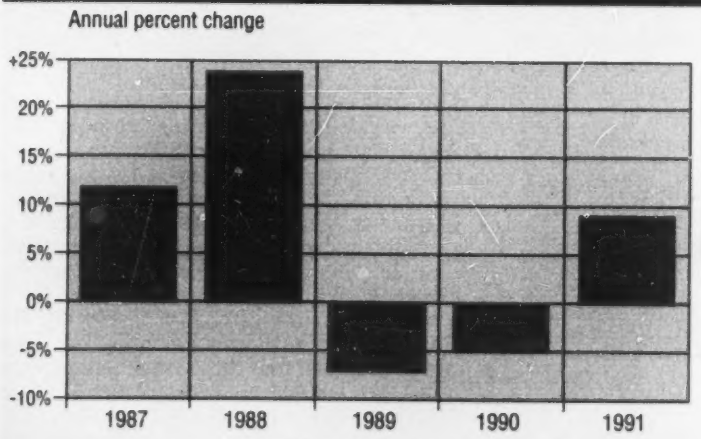
Source: U.S. Department of Commerce

...But shipments won't rebound till 1991...



Source: U.S. Department of Commerce; Forecasts: Cahners Economics

...and neither will the ATE sector



Source: U.S. Department of Commerce; Forecasts: Cahners Economics

Instruments industry poised for a recovery

An analysis of quarterly growth in new orders indicates a rebound is under way in the instruments and controls industry. Through all four quarters of 1989, year-to-year increases in new orders hovered between 2% to 3%. However, in a surprise show of strength, new orders in the first three months of this year swelled by 9% to $13.4 billion.

This orders surge for instruments and controls is translating into steady sales gains. With the 12 months ending April 1990, U.S. factory shipments jumped 5.1%, as compared with the prior 12 months. Equally important, backlogs are growing. From February to April, backlogs have inched up from year-ago levels, reversing a worrisome two-month decline in December and January.

Helping the industry along is its improved ability to control inventory. The industry has whittled its inventory to $10.37 billion as of the end of April, down from $10.56 billion at the end of April last year. This has lowered the inventory-to-shipments ratio to 2.36. Last year, months of inventory on hand hit the 2.6 mark.

Although the worst may be over for the U.S. instruments and controls industry, growth rates will not start heading up rapidly until later this year. However, some sectors of the industry that felt the worst of the slowdown will take a bit longer to recover.

The ELECTRONIC BUSINESS Automatic Test Equipment Sales Index dropped 4.8% in the first quarter of this year relative to a year ago, after falling 13% in the final quarter of last year. Expect two more negative quarters before the solid rebound in the semiconductor industry pulls ATE out of the doldrums. By the end of next year, Cahners Economics expects the ATE industry to have grown 9%. Worldwide sales of ATE equipment will reach $2.14 billion.

Shipments of all instruments and controls will grow about 4% this year and then climb 9% in 1991 and 11% in 1992. The business cycle reversal in the electronics and computer industries will mean a resurgence in investment in instruments. U.S. businesses bought about $13.9 billion worth of instrumentation and controls in 1989. That number should rise to $15.5 billion in 1990, after adjustment for inflation.

MADELINE FRANCHI

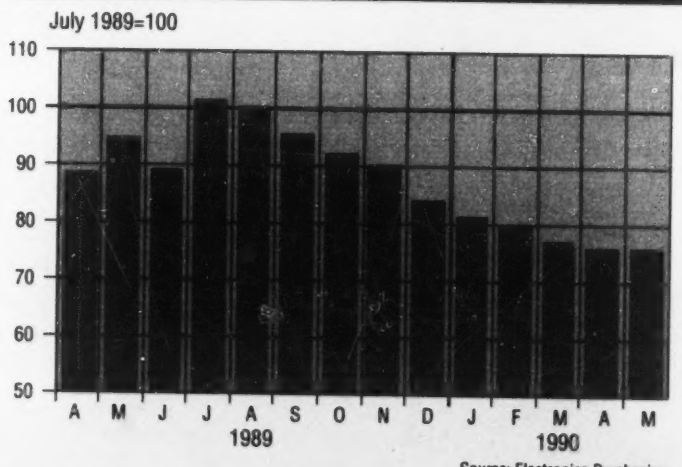
Leadtimes in detail

Average delivery time in weeks

	2Q'88	2Q'89	2Q'90	Forecast 2Q'91
Active Components				
Discrete Semiconductors	7.8	8.0	6.2	6.5
Integrated Circuits	7.5	8.3	6.6	6.9
Memory Circuits	14.3	11.3	7.4	7.6
Microprocessors	9.1	8.4	6.7	7.2
Displays	7.9	10.0	9.0	9.2
Passive Components				
Capacitors	6.9	7.6	5.6	6.2
Connectors	6.3	6.5	6.5	7.2
Printed Circuit Boards	5.8	6.5	5.6	6.0
Relays	8.2	8.9	7.5	7.6
Resistors	4.8	5.1	4.7	4.9
Switches	6.5	7.4	6.8	7.2
Wire & Cable	3.8	4.2	3.8	4.0

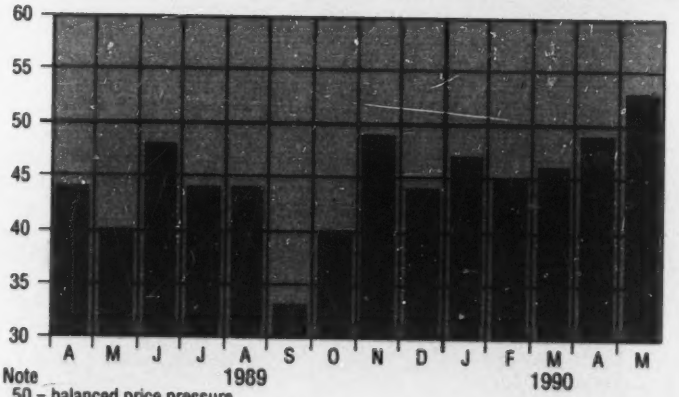
Source: Electronics Purchasing

Semiconductor price index



Source: Electronics Purchasing

Price indicator



Note
50 = balanced price pressure
<50 = downward pressure on prices
>50 = upward pressure on prices

Source: Electronics Purchasing

Shorter delivery times, but not for long

Delivery times for both active and passive components continued to shorten this past May. Leadtimes for all passive components registered only 5.2 weeks, a decline of one week from May, 1989. This slight decline was caused by shorter delivery times for capacitors, connectors, printed circuit boards, switches, relays and wire and cable.

Current weak end-market demand from computers means shorter leadtimes for many components throughout the rest of the year. Cahners Economics expects leadtimes for passive components to drop from an average 5.8 weeks in the second quarter to 5.4 weeks this quarter and 4.8 weeks next quarter. Next year, as end-market demand strengthens, leadtimes are expected to push up to over 5 weeks in every quarter.

Active component leadtimes showed more volatility as they dropped to just 6.7 weeks in May — 2.3 weeks below May of last year. Memory devices contributed the most to the overall decline in active component leadtimes. Memory ICs fell 5.8 weeks from 12.6 weeks in May 1989 to only 6.8 weeks in May this year. In particular, 1-megabit DRAM leadtimes sank to only 8.2 weeks in May, down 50% from the peak 1989 level of 16.4 weeks. Expect leadtimes for DRAMs to push up as buyers switch from placing spot orders to ordering several months in advance.

Prices holding steady

The monthly Semiconductor Price Index, tabulated by ELECTRONIC BUSINESS' sister publication *Electronics Purchasing*, has held steady at 75.8 in both April and May (July 1989 = 100). But prices are still considerably lower than May 1989, when the semiconductor price index was 94.3. While there is some sign of prices remaining stable, some evidence suggest prices may be creeping up.

The *Electronics Purchasing* Price Diffusion Indicator, measuring the movement of over 50 different electronic components, suggests an upward pricing pressure. The indicator registered 53 in May. (A value above 50 implies there is pressure to raise prices; likewise, a value below 50 indicates there is pressure to lower prices.) May is the first time in 12 months the indicator jumped above 50. While one month does not mark a trend, May's indicator may foretell the beginning of the economic rebound. The price survey reported that the average selling price of a 1-Mb DRAM popped up from $7.25 in March to $7.73 in both April and May.

JULIE HANDELMAN